INTERNATIONAL SERIES ON INFORMATION SYSTEMS AND MANAGEMENT IN CREATIVE eMEDIA

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International Series on Information Systems and Management in Creative eMedia

The International Series on Information Systems and Management in Creative eMedia is advancing the knowledge of the use of informaiton systems and management in the wider field of creative eMedia industries. The series covers a wide range of media , such as television, publishing, digital games, radio, ubiquitous/ambient media, advertising, social media, motion pictures, online video, eHealth, eLearning, and other eMedia industries.

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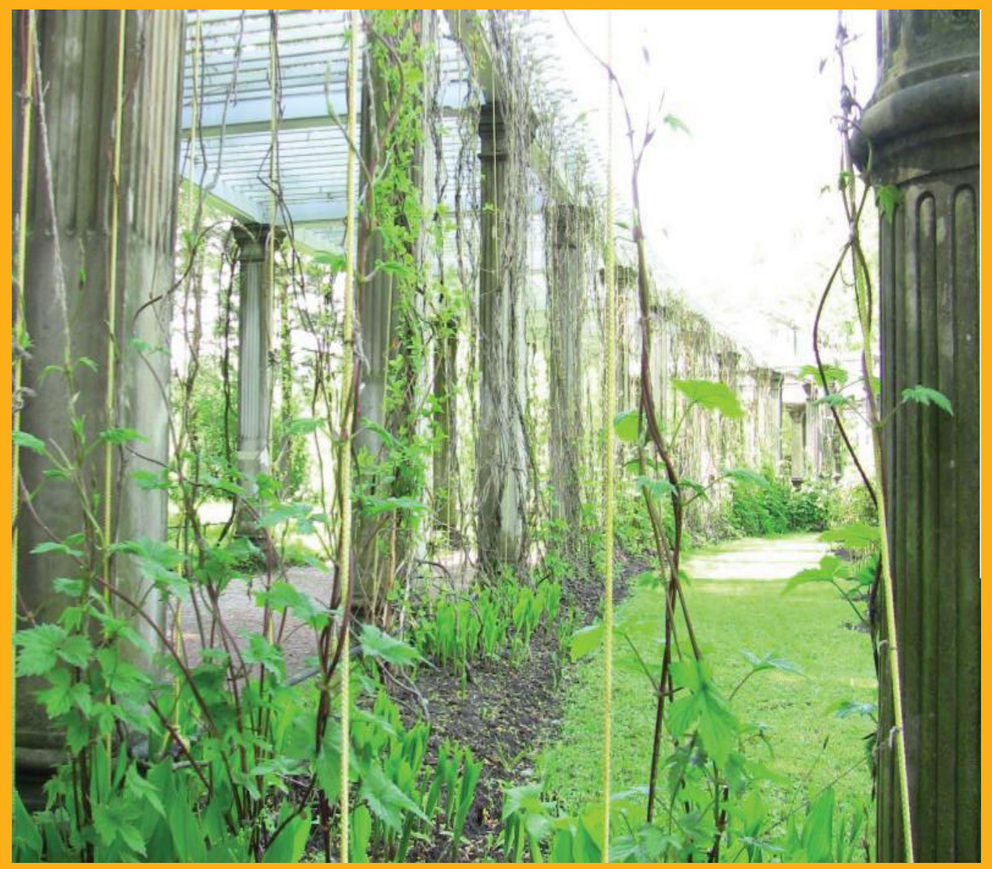
Proceedings of the 4th Semantic Ambient Media Experience (SAME) Workshop: In conjunction with the 5th International Conference on Communities and Technologies (C&T 2011) Brisbane, Australia, 29th June-1nd July 2011



IS&M in Creative eMedia

Artur Lugmayr, Thomas Risse, Bjorn Stockleben, Juha Kaario, Bogdan Pogorelc, and Estefania Serral Asensio (Eds.)

Proceedings of the 4th Semantic Ambient Media Experience (SAME) Workshop in Conjunction with the 5th International Convergence on Communities and Technologies

Brisbane, Australia, 29th June-2nd July, 2011

This event is in cooperation with the Ambient Media Association (AMEA) (www.ambientmediaassociation.org)

This event is technically endorsed by the COST Action IC 1003 Qualinet (http://www.qualinet.eu)

EMMi Lab, Tampere University of Technology (TUT), Tampere, 2011

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Preface

Since three years the Semantic Ambient Media Experience (SAME) workshop series attracts delegates and presenters from many fields including education, business, government, technology, and media to discuss and shape ambient media. As the SAME workshop series is a think-tank for creative thinkers, it's a special workshop format which aims at team-work and working together on envisioning the future of ambient media. This year's call for position papers led to 14 submissions, where 13 submissions were accepted and are published within the conference proceedings after a double-blind review process. Submissions where coming from 9 different countries (Australia, Canada, Finland, Germany, Republic of Korea, Serbia, Slovenia, Sweden, and USA).

The SAME workshop series led to the establishment of the Ambient Media Association (AMEA), where several workshop results and outcomes can be found online (www.ambientmediaassociation). In previous years, the workshop resulted in two special issues published by Springer-Verlag:

- Lugmayr, A.; Risse, T.; Stockleben, B.; Kaario, J. & Laurila, K. Special issue on semantic ambient media experiences *Multimedia Tools and Applications,* **2009***, 44*
- Lugmayr, A.; Risse, T.; Stockleben, B.; Kaario, J. & Laurila, K. Special issue on semantic ambient media experiences *Multimedia Tools and Applications,* **(to be published in 2011)**
- Lugmayr, A.; Risse, T.; Stockleben, B.; Kaario, J. & Laurila, K. Special issue on semantic ambient media experiences *Multimedia Tools and Applications,* **(to be published in 2012)**

SAME took place in 2008 in conjunction with ACM Multimedia 2008 in Vancouver, Canada; in 2009 in conjunction with AmI 2009 in Salzburg, Austria; in 2010 in conjunction with AmI 2010 in Malaga, Spain, and this year's edition in Brisbane, Australia.

The workshop organizers present you a fascinating crossover of latest cutting edge views on the topic of ambient media, and hope you will be enjoying the reading. We also would like to thank all the contributors, as only with their enthusiasm the workshop can become a success.

This event is in cooperation with, and organized by the Ambient Media Association (AMEA, www.ambientmediaassociation.org) and the Entertainment and Media Management Lab. (EMMi Lab.) at Tampere Univ. of Technology (TUT, http://www.tut.fi/emmi). We also would like to acknowledge COST Action IC 1003 Qualinet for the technical endorsement of this workshop (http://www.qualinet.eu).

Artur Lugmayr
Thomas Risse
Bjorn Stockleben
Juha Kaario
Bogdan Pogorelc
Estefania Serral Asensio

Brisbane, Australia, 2011

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Call for Papers

Call for Workshop Position Papers
SAME 2011 – 4th International Workshop
on Semantic Ambient Media Experience (NAMU Series)

29th June-2nd July 2011
in conjunction with the
5th International Conference on Communities and Technologies
Brisbane, Australia
http://www.ambientmediaassociation.org/node/60
http://ct2011.urbaninformatics.net/

Creating the business value-creation, vision, media theories and technology for ambient media

this event is technically endorsed by the COST Action IC 1003 Qualinet
http://www.qualinet.eu

Call for Papers
The medium is the message! And the message was transmitted via a single distinguishable media such as television, the Web, the radio, or books. In the age of ubiquitous and pervasive computation, where the information goes through a distributed interlinked network of devices, the question "what is content in the age of ambient media?" becomes more and more of importance.

Ambient media are embedded throughout the natural environment of the consumer – in his home, in his car, in restaurants, and on his mobile device. Predominant example services are smart wallpapers in homes, location based services, RFID based entertainment services for children, or intelligent homes. The distribution of the medium throughout the natural environment implies a paradigm change of how to think about content.

Until recently, content was identified as single entities to information – a video stream, audio stream, TV broadcast. However, in the age of ambient media, the notion of content extends from the single entity thinking towards a plethora of sensor networks, smart devices, personalized services, media embedded in the natural environment of the user and even the World Wide Web. The user actively participates and co-designs media experience with his location and context based input. Initiatives as the smart Web considering location based tagging for web-pages underline this development.

This multidisciplinary workshop aims at a series, and at the creation of a think-tank of creative thinkers coming from technology, art, human-computer interaction, and social sciences, that are interested in glimpsing the future of semantic ambient intelligent empowered media technology. Thus, the workshop aims to answer to the challenges how to select, compose, and generate ambient content; how to interpret content for the ambient presentation; how to re-use ambient content and learning experiences; what are the characteristics of ambient media, its content, and technology; and what are ambient media in terms of story-telling and art. And finally, how do ambient media create business and value? How can ambient media be integrated into business processes and strategies?

In addition, Semantics plays a crucial role in the generation of ambient media content. It can be seen as the glue between the raw data and the ambient media. Therefore we are interested to see innovative ideas how data can be (semi-)automatically be interpreted and translated into media presentations.

Workshop Challenges
• What is 'content' and how can it be presented in the age of 'ubiquitous' and 'pervasive'?
• How to select, compose and generate ambient content?
• How to interpret content for an ambient presentation?
• How to manage and re-use ambient content in specific application scenarios (e.g. e-learning)?
• What is interactivity between the single consumers and consumer groups in the ambient context?
• How can collaborative or audience participatory content be supported?
• How can sensor data be interpreted and intelligently mined?
• How can existing media such as TV, home entertainment, cinema extended by ambient media?
• How can ambient media be applied in business processes?
• How do ambient media create value and business?
• Business opportunities and strategic issues of ambient media?

• Which methods for experience design, prototyping, and business models exist?

More information on the previous International Workshops on Semantic Ambient Media Experience:

- 1st International Workshop on Semantic Ambient Media Experiences held in conjunction with ACM Multimedia 2008, http://portal.acm.org/toc.cfm?id=1461912&type=proceeding&coll=ACM&dl=ACM&CFID=96753168&CFTOKEN=49706448
- 2nd International Workshop on Semantic Ambient Media Experiences held in conjunction with AmI-09, http://webhotel2.tut.fi/emmi/forum/node/55
- 3rd International Workshop on Semantic Ambient Media Experiences held in conjunction with AmI-10, http://www.ambientmediaassociation.org/node/56

Topics of Interest

The following (and related) topics are within the scope of this workshop and shall act as examples:

* Supply chain management with ubiquitous computation
* eCommerce & ubiquitous commerce
* Business processes, value-creation, and opportunities of ambient media
* Understanding of the semantics of ambient content and methods to intelligence to daily objects
* The World Wide Web in the context of ambient media
* Mobile and stationary sensor data collection and interpretation algorithms and techniques
* Context awareness and collection and context aware composition/selection of ambient content
* Creation and maintenance of meta-information including metadata and data management
* Ambient and mobile social networks, user generated content, and co-creation of content/products
* Ambient Assisted Living (AAL)
* Characteristics of ambient media, its content, and technological platforms
* Ambient content creation techniques, asset management, and programming ambient media
* Algorithms and techniques for sensor data interpretation and semantic interpretation
* Applications and services, including ambient games, art and leisure content in specific contexts
* Ambient interactive storytelling, narrations, and interactive advertising
* Personalization, user models, multimodal interaction, smart user interfaces, and universal access
* Experience design, usability, audience research, ethnography, user studies, and interface design
* Business models, marketing studies, media economics, and 'x'-commerce of ambient media
* Ambient interfaces (touch, gesture, haptics, biometrics)
* Management of information, knowledge and sapience in the context of semantic ambient media
* Methods for context awareness, sensor networks, and sensor data mining
* Semantic data mining and text mining for pervasive media
* Semantic models, semantic interpretation for ambient media presentation;
* Personalization and methods for locative media

The workshop aims at a series, and at the creation of a think-tank of creative thinkers coming from technology, art, human-computer interaction, and social sciences, that are interested in glimpsing the future of semantic ambient intelligent empowered media technology. We are aiming at multidisciplinary, highly future oriented submissions that help to develop the "ambient media form" for entertainment services, such as:

* case-studies (successful, and especially unsuccessful ones)
* oral presentation of fresh and innovative ideas
* artistic installations and running system prototypes
* user-experience studies and evaluations
* technological novelties, evaluations, and solutions

Target Audience

The target audience are researchers and practitioners in the field of ubiquitous and pervasive computation and its related areas. These include pervasive computation, emotional computation, content creation, ubiquitous computation, human-computer-interaction and usability experts, mobile industry, service creators, etc. Workshop participants shall have previous experience in this or related fields to be able to contribute on a high scientific level. The workshop participants will actively contribute to the development of semantic ambient media, due to a different method of workshop organization. Participants shall participate rather than passively contribute. The participants shall discuss and actively elaborate the topic and we plan to kick-off an international web-based informal forum for ambient media, which shall increase the effect of this workshop tremendously.

We strongly welcome multidisciplinary contributions coming from the media technology, business, artistic, and human experience side. Case studies (successful and especially unsuccessful), artistic installations, technologies, media studies, and user-experience evaluations are highly welcome, which are affecting the development of ambient media as new form of media. Especially visionary contributions shaping the future of ambient media are strongly welcome.

Paper Submission

- Submissions are expected to be 2-4 pages position papers according the paper format of C&T available at http://www.sigchi.org/chipubform
- Please submit your paper at our paper submission system: http://webhotel2.tut.fi/emmi/Conferences/2011same/openconf.php
- Best contributions will be compiled to a special issue following up the workshop - we aim at Springer MTAP after reviewing the quality of contributions
- Check also the Ambient Media Association (AMEA): www.ambientmediaassociation.org

Important Dates

* paper submission: 15th March 2011
* notification of acceptance: 1st April 2011
* final papers due: 15th April 2011
* workshop day: 29th June 2011
* special issue articles due: 30th August 2011

Workshop Chairs

* Artur Lugmayr, Tampere University of Technology (TUT) & lugYmedia Inc., FINLAND
* Thomas Risse, L3S Research Center, GERMANY
* Bjorn Stockleben, Univ. of Applied Sciences Magdeburg, GERMANY
* Juha Kaario, Varaani Works Oy, FINLAND
* Bogdan Pogorelc, Jozef Stefan Institute & Spica International d.o.o., SLOVENIA
* Estefania Serral Asensio, Universidad Politécnica de Valencia, SPAIN

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* Guillermo Talavera, CAIAC, Universitat Autonoma de Barcelone, SPAIN
* Mark Bilandzic, Queenland University of Technology, AUSTRALIA

Workshop Programme

Schedule

09:00-09:30 Introduction
09:30-11:00 Presentation I (15+5 mins/4 papers)
COFFEE
11:00-12:00 Two Team Q&A + Presentation
FOOD
13:00-14:30 Presentation II (15+5 mins/4 papers)
COFFEE
14:30-15:30 Two Team Q&A + presentation
COFFEE
16:00-17:00 Two Team Vision + presentation

Questions

- What are the technical enabler of ambient media?
- What are the motivating forces?
- Business
  - How can ambient media be applied in business processes?
  - How do ambient media create value and business?
  - Business opportunities and strategic issues of ambient media?
- Content & the Media
  - What is 'content' and how can it be presented in the age of 'ubiquitous' and 'pervasive'?
  - How to select, compose and generate ambient content?
  - How to manage and re-use ambient content in specific application scenarios (e.g. e-learning)?
- Interactive Design & Experience
  - What is interactivity between the single consumers and consumer groups in the ambient context?
  - How can collaborative or audience participatory content be supported?
- Models, Methods, Concepts & Frameworks
  - Which methods for experience design, prototyping, and business models exist?
  - How can sensor data be interpreted and intelligently mined?
  - How can existing media such as TV, home entertainment, cinema extended by ambient media?

Presentation I and II

- 15 minutes + 5 minutes Q&A
- Pitching of own viewpoint
- Clarify own viewpoint
- Present the key-issues of your work!
- Workshop visitors give analyze and give feedback
- ***Presentation of the 'fishbone'***

Team Q&A

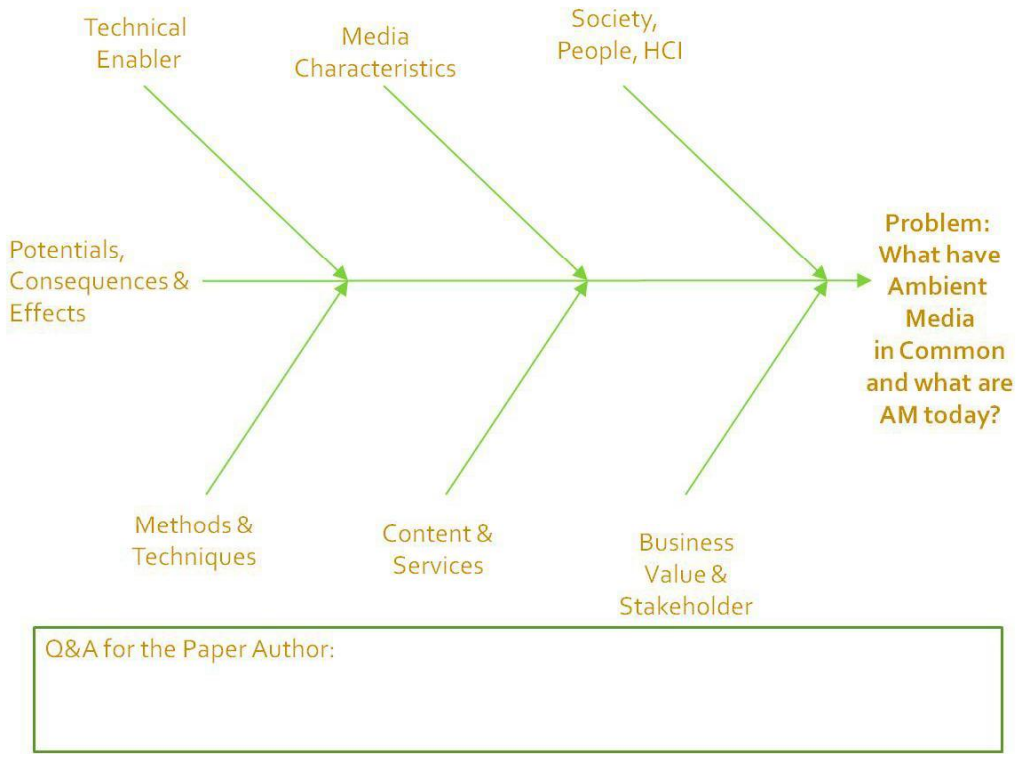
- Q&A in 2 groups
- Build groups
- Get the experienced one's on board
- Where are your weaknesses?
- Where are your strength?
- Where do you need help?

- Helping each other to fill a final fishbone for the paper
- Goal:
  - filling one common fishbone for the papers
- Quick Pitch:
  - 2 minutes/group of the fishbone

Is&Maybe&IsNot

- Fish bones as input
- What needs to be developed in the future?
- What are the next steps of ambient media?
- What are ambient media in 2030?
- What are ambient media not in 2030?
- Where is the gray zone of ambient media in 2030?
- How will ambient media be defined in 2030?
- How does the own project fit?
- **Presentation**
  - demonstrate the vision of ambient media in 2030
  - sketches, drafts, paintings, PowerPoint's, fishbone,…

Fishbone Template



Philosophy of Universal Games Design

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ABSTRACT
The philosophy of information is the area of research that studies conceptual issues arising at the intersection of computer science, information technology and philosophy. Universal design is a concept that emphasizes the importance of non-specialized features in things and environments. As participation in gaming increases around the world and across a larger part of the population, the path towards achieving universal design and change of attitude in our mind is clear but requires that we think globally and frame the issues a little differently. This article aims to see universal design concept; its principles, uses, design processes, from a philosophical view point in terms of games design. It concludes by arguing that universal design of games is not a style but an attitude of accepting the difference and responsibility of ours and also proposes what needs to be done for upholding universal game design concept.

Keywords
Inclusive Design, Universal Games Design, Accessibility, Design for All, Philosophy of Universal Design.

INTRODUCTION

Design for All or Universal Design is a concept that has more and more support around the world. However, there are still habits, ignorance and wrong priorities that need to be overcome. The challenge is clear: we must "mainstream" Design for All. The world is changing faster than ever before. The world today is not anymore made up of different countries. Thanks to the Communication Revolution and Globalization, the world is one. The world is not any more a globe. As Thomas Freidman informed us rightly, the world is flat [1]. Distance is dead and time has become an instant. Information is at the touch of a button and communication is possible 'any where any time'.

Naturally, Design cannot remain untouched by this challenge of change. The old notion of design definition has changed. Now design is not a problem solving activity anymore, but people satisfying profession. Form follows neither function nor fun anymore. Form follows people. Design is the only profession which has the unique ability to challenge conventions, and thereby improve the quality of life and social environment. Design has the unique ability to influence market forces as well as better the social and cultural experience of things in everyday life including ambient media. Design is a great power because it can influence the mind sets of people. With great power comes great responsibility for the users of the product or service designed for them. A responsible design education must instill in young minds a good system of values. By design, the public should be motivated towards making an integrated society which is presently getting fragmented by over-individuality nurtured by indispensable gadgets such as Cell phones, lap tops and I-pads. Computer games are not an exception from this discussion. In fact the ambient media's use in a gamely way is getting popular for mass population. Hence to consider the design of computer games in universal design way for enhancing future ambient media use is vital.

PRINCIPLES OF INFORMATION SCIENCE

As Hjørland states, one should not regard something like an algorithm as a neutral tool instead one should ask what kind of requests are considered by this tool and what kind of requests are relatively bad considered [2]; we can use this analogy in terms of universal design and find the answer what actually universal design means. What are the part of design that should be considered bad and improved thereby and what kind of request is made by our design? Also the system that is designed, is it best for humanities, asked by Hjørland [3]? This brings the issues of universal design in terms of inclusive design for accessibility. Is something that is being designed, accessble for limited user group regardless of physical disability? Also Hjørland argues that different subject access points are used differently in different domain and traditions and have thus different informational values in different contexts [2][3]. Considering this, I would like to say that if we consider human modalities to be individual domains, we can use multiple subject access points to find the information for that particular domain and use the

result to crerate multimodal system which leads towards universal design. As defined by Floridi, the philosophy of information can be a well defined new field if it is rich enough to be ogranized in clear subfiel and hence allow for specializaion[4][5].Using this corelations I would like to argue that the universal design field can be considered to be a principal domain full of information from where it is possible to expand to the subfields such as games design. Thus organizing the subfield's design which may involve specialied design methodology, the goal of the taget domain (universal design in this case, for games) can be achieved.

UNIVERSAL DESIGN

Universal Design Principles

The original set of universal design principles, described below was developed by a group of U.S. designers and design educators from five organizations in 1997 [6]. The principles are copyrighted to the Center for Universal Design. The principles are used internationally, though with variations in number and specifics analogy.

1. *Equitable Use:* The design does not disadvantage or stigmatize any group of users.
2. *Flexibility in Use:* The design accommodates a wide range of individual preferences and abilities.
3. *Simple, Intuitive Use:* Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
4. *Perceptible Information:* The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
5. *Tolerance for Error:* The design minimizes hazards and the adverse consequences of accidental or unintended actions.
6. *Low Physical Effort:* The design can be used efficiently and comfortably, and with a minimum of fatigue.
7. *Size and Space for Approach & Use:* Appropriate size and space is provided for approach, reach, manipulation, and use, regardless of the user's body size, posture, or mobility.

I would like to contribute to a fairly diverse way of thinking about the principles of universal design. In this scheme, evenhanded use is the overarching and transformative principle that drives the integration of two types of principles: functional principles and process principles. This is derived from the work of Wayne State (Michigan) Professor Robert F. Erlandson [7]. He works in engineering and product development but his ideas have relevance for the built environment as well as information and communication technology (ICT). The "process" principles vary very little from the familiar seven principles but he adds three broad classifications of functional limitation [7]: ergonomic (mobility, dexterity, strength limitations), perceptible (sensory including sight, hearing, speech, touch), cognitively sound (functional issues that are brain-based and include learning differences, intellectual limitations, psychiatric conditions, brain injury and issues from simple memory loss to dementia related to aging) [7].

Integrated Sustainable Design

Over the last fifteen years, universal design has achieved a slow but steady increase in awareness. Over a little longer period and most especially in the last five years, we have witnessed an extraordinary embrace of environmental sustainability as central to good design. In much of the world, sustainability is understood to be the triple bottom line of environmental, social and economical sustainability. To quote from the American Institute of Architects' Committee on the Environment: *Sustainability envisions the enduring prosperity of all living things*. Sustainable design seeks to create communities, buildings, and products that contribute to this vision.

It is time to consider the strategic value and practical opportunity of bringing universal design under the tent of sustainability. Socially sustainable design tends to be the vaguest element of the sustainability tripod – full of general good feeling but lacking substance. Universal design is real and substantive and responsive to the truth that no design in the 21st century can be sustainable without attention to the facts of human diversity in age and ability.

Universal Design as Our Responsibility

According to Floridi, four kinds of mutually compatible phenomena are commonly referred to as information [4][5][8].

- Information about something (e.g. a train timetable)
- Information as something (e.g. DNA, or fingerprints)
- Information for something (e.g. algorithms or instructions)
- Information in something (e.g. a pattern or a constraint).

The word "information" is commonly used so metaphorically or so abstractly that the meaning is unclear [5][8].

Based on this analogy I would like to classify different levels of responsibility towards society to be a kind of information for us or to others.

1. Individual Responsibility (Information about something)

- Avoid "sympathy". What is needed is "Empathy".
  Don't ignore the differences but recognize and embrace the differences Ex. the male and female.
- A spirit of mutual enrichment.
  For example, the aged are fund of experience and accumulated wisdom to be utilized. They have money, time and often name and contacts useful to young people and children, while the young can give them physical care, company and love.
- Awareness of the built environment and products, which are inclusive.

2. Institutional Responsibility (Information for something)

- Need to educate the minds from primary school level about 'loving and living with differences'.
- Design schools must ensure at least one project by every student on 'including differences'.
- Design schools must have a faculty in 'Design for Diversity'.
- Masters level specialization in Design for Diversity.

*3. Corporate Responsibility (Information as something***)**

- Awareness promotion as corporate social responsibility
- Funding Universal Design Projects in various ways.
- Being a good example in adopting Universal Design in their Employment policies, factories, offices, etc.

4. Government Responsibility (Information in something)

- Make public policies to encourage Universal Design.
- Enforce the policies made.
- Offer Incentives such as tax benefits subsidies etc

Design Process for Universal Design

According to Floridi [4][5][9] the three membrane model or metaphor was used to constitute the design process for universal design. The structural, informational and mental membrane can be considered on the three layers of a pyramid from bottom to top. If we follow the hierarchy from a bottom up approach we can find that the design should first consider structural requirements and then informational requirements in the next phase that deals with psychology [4][5][8][10]. The third mental membrane gives us the awareness, from the pre-conscious to the post-conscious self awareness for the overall idea of the universal design. Therefore the design progression involves the enhancement of individuals, empowering of organisms and extension of minds [12][13]. The aim of Universal Design is not mere creation of products to fit a variety of people but to change our attitude towards differences, to create human integration and celebration of diversities.

The design process adopted for Universal Design therefore should have the following factors according to Floridi's membrane model, while considering universal games design [4][5][8][10].:

- All users including people with disabilities should have the opportunity to use and benefit from the latest technological advances.
- The designer must have personal experience of a difference or a disability through simulation exercises.
- User participation in a design right from the beginning is essential.
- Universal design as a method should not be an excuse for not enforcing public policies and not ensuring individual adaptation and assistive technologies.

Universal Design and Business-Perspective Games

In any business the priority is profit because a company is responsible for its shareholders. Accepting this I would say that universal design is not necessarily altruism. Based on the previous discussion on domain of information by Hjørland [2][3], universal design of games is good business for three reasons:

Firstly Universal Design is good business because the diverse population is huge and increasing. If according to business guru CK Prahlad, there is fortune at the B.O.P

(bottom of the pyramid) [15], I would argue that, there is fortune at the S.O.P. (sides of the pyramid) too. In every economic class, there is a proportion of people who are different and in dire need of design. It is a vast, fast growing and affordable market. Secondly, business exists only if society appreciates it. Universal Design brings such social appreciation. Thirdly, it is human resource for employment. A difference or disability, innovatively used could be an advantage.

Ambient Media and Universal Design

Since ambient media is now firmly established within the industry, universal design concept is no longer limited within the boundary of creating product or designing media for physically disabled people. The declination of traditional media and the general versatility of ambient media make it questionable to consider universal design methodologies. Computer games are a form of ambient media used for several purposes including learning, entertainment, education etc. To successfully achieve the manifestation of ambient media using computer games it is therefore important to consider universal design philosophies. The manifestation, morphing, intelligence and experience principles of ambient media through computer games can be successfully delivered to the target users when universal design concepts are considered for broad perspective of user along with the future users of the ambient media. Since ambient media is already popular, users should not be excluded because of the design issue of ambient media and universal design concept will play an important role regarding this. In the coming future computer games will be a tool for promoting ambient media in greater extent hence considering universal design philosophy has remarkable impact on ambient media.

CONCLUSION

Erlandson's organization of principles [7], addresses two vulnerabilities in universal design. First, as noted above, too often people assume that universal design is a synonym for barrier-free or accessible design. Many people think of universal design as focused primarily on the same conditions as barrier-free: people with mobility limitations especially wheelchair users and people who are blind. The second vulnerability is that it appears to promise too much. Too broad, it becomes meaningless – more concept than design strategy. The Erlandson scheme [7] of adopting three broad categories of human function captures the vast majority of conditions. It makes it easy to understand that barrier-free/accessibility is a floor upon which to build universal design. It makes it easier for a client to appreciate the difference between barrier-fee and accessibility and universal design. It points to the reality that we need more research and innovation to expand a repertoire of design solutions.

Floridi's argument about Egology [11][12][13] and its two branches are considered here. Diachronic egology is important here for personal identity or re identification through time or possible worlds. It is important to understand who we are at first place and important to understand that we will become somehow disabled some day and universal design is important thereby. For designers being considered to be the part of synchronic egology it is important for them to re-characterize in time or a possible world considering that the designers are not necessarily all the time the users of the product or service[12][13]. They should consider themselves that the product or service can be used by a vast majority with many limitations hence a change of attitude is required. So both diachronic and synchronic egology is important in defining the user, the designers and also while they are closely working together to design something universally. Diversity (disability, old age included) is not someone else's problem, it is *OUR PROBLEM*. We all will go through old age, illness, and restrictions in lifestyle etc at one stage or the other in life. We ourselves become different. Most ills in today's society are due to *our disability* to appreciate our 'differences' and accepting the 'other'. The path towards achieving universal design and change of attitude in our mind is clear but requires that we think globally for instance for the purpose of designing games and frame the issues a little differently. Design practitioners in the built environment have not, in general, undertaken the same progress toward user-centered and universal design that we have witnessed in product design and technology. Their focus remains most often on barrier-free/accessible requirements.

The definition of information that the inclusive designer or universal designers perceive might not be same as the way users or others perceives. But it does not matter according to Hjørland [2]. What matter is to understand the nature of a system and try to understand the behaviors of another system that we need to consider parallel for design purpose and then construct and define a third system. Also by building a system to help the people in another system is the aim according to Hjørland [2][3]. For doing so, the behavior of another system needs to be changed too, which can be our mental model, our way of thinking, our attitude and so on.

I would propose that we make several priorities as we move forward from this crisis and consider how to protect and grow the universal games design movement. As Floridi's 'digital gaze' [14], states that, it must be understood both as an instance of presumed common

knowledge of the observation and as a private experience. Considering the characteristic of digital gaze some proposal towards universal design is stated in the following points:

- Learn the multiple ways to market and promote universal games design globally that respects the social and cultural differences. Find new ways to talk to new markets. Japan has created a successful but unique society-wide market for universal design. We need to find ways to bring great universally designed products of all kinds to societies unable to hear or appreciate the language of universal design. Evaluating options for pairing of environmental sustainability and universal design as social sustainability is one of those strategies.
- Share stories of success globally but generate excitement about the next chapter. Conferences are wonderful opportunities to learn the state-of-the-art but they should also be catalysts for the next generation of ideas and for the literal next generation of young people who will carry on this mission. Engage them through competitions and other opportunities to get involved. In times when travel may prove impossible for many, sharing the experience through digital technology is likely to be more important than ever.
- In most of the world there is still an unmet need for robust economic models that make the case for universal design in a similar way to the powerful economic models that have been so instrumental in moving environmental sustainability forward. How to measure the benefits of doing it and the costs of avoiding it is a challenge.

We all must address universal design of games as a part of the society and particularly as responsible design professionals.

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Bringing Health Telemonitoring into IPTV Based AMI Environment

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ABSTRACT
In this paper, we describe the development of a personal-health telemonitoring application which is integrated into the Internet television based home communication environment. The application presently enables monitoring of blood pressure and body weight and supports on-line medical interviews. We present the functionality of this application. Its key feature is the user interface, manageable by a simple TV remote-control. The implementation results in a software widget, which is installed in a net-top-box. It builds the user interface, provides monitoring of measurement devices and communications with the back-end systems.

We conducted an evaluation of the overall user experience, which shows very encouraging scores. Beside this, the application enables personal-health service that is comparable to the one, provided by dedicated personal-health systems. At the same time, its open architecture allows for future extensions and simple inclusion of other health monitoring areas.

Keywords
Personal health system, PHS, IPTV, net-top box, NTB, blood pressure, weight, usability evaluation

INTRODUCTION

The emerging information and communication technologies (ICT) can importantly support social-, health- and security-related challenges in a modern society. Ambient intelligence solutions (AMI) are evolving into convergent, multimedia and multipurpose systems. One of possible usage scenarios of AMI are personal-health systems (PHS) [13]. PHS improve healthcare by prevention or remote health monitoring. PHS combined with AMI have an emphatic role for elderly user, because they support ageing well and independent living in their home environments, too [11].

Background on Health and Safety Related IPTV Solutions in AMI Environments

Our research combines several broad technology- and user-related areas. Despite this the intersection is rather specific and narrow.

Important aspects of AMI are health and safety related applications. Although these applications can be valuable for every home user, their importance increases for older adults [1], [7]. There are many examples of successful telemonitoring trials. They are ranging from technologically simple, but clinically thoroughly elaborated observations of small sets of physiological parameters [5] to sophisticated behavioural monitoring of elderly at home [8]. However, not many IPTV systems supporting telehealth services have been reported. The Phillips Motiva [13] is among most frequently applied ones is. It is based on an IPTV platform with telecare and telehealth interfaces built in the STB by the manufacturer. The system has been implemented, among others in a trial conducted by Newham Council and Primary Care Trust [18].

Most currently deployed IPTV systems rely on powerful back-end platforms and simple dedicated user terminals, i.e. set-top-boxes (STB). A STB has usually very limited computational resources, mostly dedicated to the display of the selected TV channel and the creation of IPTV user interface. Introduction of additional services on STB platform is complicated and completely left to the STB manufacturers and IPTV platform developers. With latest developments STBs can be replaced by net-top-boxes (NTB). A NTB offers all the functions found in STB. But NTBs are typically based on personal computer-like hardware platforms and apply derivates of readily available operating system. Introducing new functions into a NTB is therefore much more open and can even bypass the IPTV platform and service providers.

Implementing the support in NTB makes the introduction of telemonitoring in home environments easier. We can decouple the monitoring from IPTV provisioning. Despite this, the NTB is the only additional part of the communication equipment and the telemonitoring remains seamlessly integrated in the TV user-interface. Additional benefit of powerful NTB platform is support for other multimedia and communication features. They can complement telemonitoring with educational material, provide reminders and interactive medical questionnaires or add real-time communication support.

In this paper, we present design, implementation and brief usability evaluation of a personal-health system which is integrated into an IPTV home-environment and implemented in as a net-top-box application. A user applies this system with a plain remote-control and TV-set. These are two devices that most of the intended users are very familiar with. This approach to some extent differs from user terminals in AMI environments, where commonly portable or wall-mounted touch-screens are applied. PHS which is integrated in NTB minimizes new or additional dedicated equipment at the user side. Integrated implementation of a PHS can be thus more cost effective - showing an important additional benefit for ICT service providers.

System Description

The personal health solution described in this paper was developed within a wider intelligent-living environment developed at the Faculty of Electrical Engineering, University of Ljubljana. This test environment features an array of services for ambient assisted living, such as home automation control, energy resource consumption monitoring, home alarm control and health telemonitoring. For each service, a set of physical devices such as switches and sensors are installed in the environment. These devices feature various communication interfaces, using which they connect to an integrated communication gateway designed to convert local multi-protocol communication into Internet-like communication standards such as Internet protocol, Simple Object Access Protocol (SOAP) and Extensible Markup Language (XML). In this way, the home environment is connected to a server back-end, which is divided into elements hosting central control on one side and application logic on the other. Users can control the test living environment in various ways. Apart from Web-based interfaces for standard personal computer and mobile clients, IPTV user interfaces for various set-top-box (STB) and NTB platforms were developed.

Functional Description

Our aim was to define and implement a personal-health application which is fully integrated into the domestic IPTV environment and is optionally connected to back-end system, responsible for advanced health monitoring services and features.

From the end-user perspective management of the application relies on remote-control and presentation on a TV screen. Its' use is therefore expected to be equally straightforward and easy for the users as any other TV applications they are already familiar with (e.g. using electronic program guide, browsing for information on the TV). This provides a potential to bring the PHS functionality to users in a new and accessible form (Figure 1).

Figure 1: User-interface of the IPTV based health telemonitoring system

The current implementation enables blood-pressure and weight measurements with rather common sensors and weight scales that have built-in communication interfaces. The measurement results are automatically read from the device and stored in the NTB. The TV user receives a notification about new PHS data in the NTB interface (Figure 2). Every measurement can be accompanied by a short on-line interview providing the basic medical history relevant for a particular measurement (Figure 3). User can then review edit or delete the existing measurements. The measurement history is presented in a tabular or graphical form (Figure 4).

Figure 2: Measurement alert and user authentication

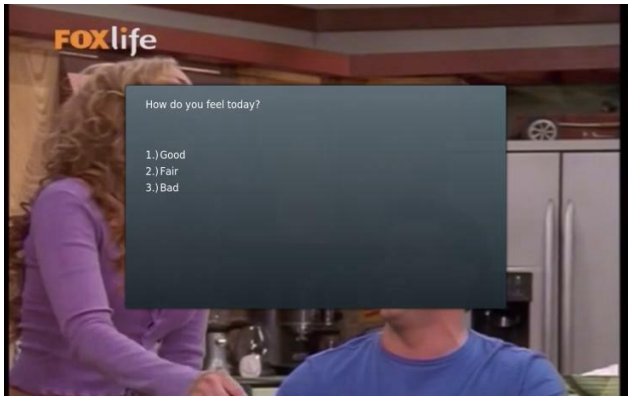

Figure 3: Conducting the medical interview

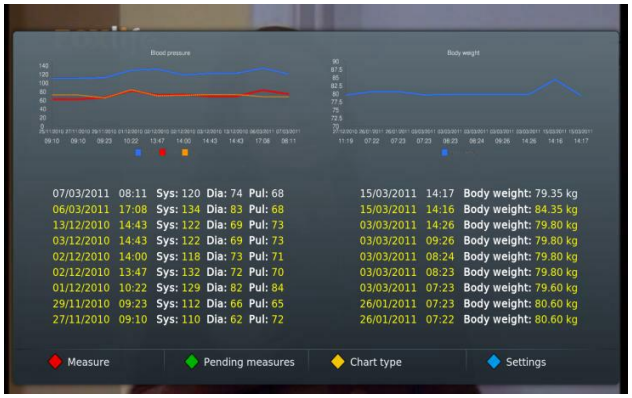

Figure 4: Review and management of measurements

A background communication service assures simultaneous upload of measurement values and corresponding meta information (e.g. time-stamps, user identifications) to a back-end system. The back-end provides non-end-user features like storage of larger history sets of data, application support for medical staff (e.g. doctors, nurses) responsible for monitoring the patients and integration with medical data exchange systems.

The application has a multi-user support. The same NTB can therefore be used by more than one user (e.g. several family members, habitants of a retirement home). User is authenticated by a PIN or smart card. If the system is used by a single user, authentication steps can be bypassed.

Special attention was devoted to the simplicity of the graphical user interface (GUI). We have taken into account that the application should be easy to use both for average TV users as for elderly people. Various GUI-development guidelines [4] were taken into account, such as usage of large text fonts and images, basic colors and simple navigation, adapted to usage of the remote control. We believe that the GUI is one of key factors for application usability.

Technical Description

The personal-health application was implemented as script application for XBMC Media Center [19]. This NTB-based IPTV solution already comes with basic features, including Live TV, personal video recorder, electronic program guide and various entertainment-, social- and collaboration-based applications. It also provides a framework for deploying additional plug-in applications. This will enable us to add additional e-health features later on.

We have chosen two personal health devices, a blood pressure monitor [15] and a weight scale [16] to work with our application. These devices are equipped with Bluetooth and RS-232 communication interfaces that enable measurement results to be transferred into the application. Other devices, such as spirometer or glucose meter can be also added later on to extend the functionality of the application.

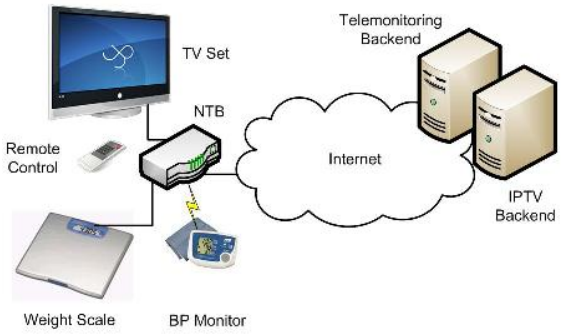

Figure 5: Application architecture

The application comprises three principal modules. The core module implements the basic application features, such as presentation of graphical user interface, revision of measurement results and administration of users, settings and questionnaires for medical interviews. The core module utilizes Google Chart API [9] for generation of the charts. It acts as a communication gateway, too, by implementing web services for the transfer of the measurements from the home environment to server back-end. Two separated modules are in charge of capturing the measurements via Bluetooth and RS-232 device interfaces. They continually check these interfaces. In case of a new measurement, the data is instantly read from the device and written into dedicated files on NTB, and the core module is triggered.

METHODOLOGY FOR USER EVALUATION STUDY

For evaluating the overall user experience of the personal-health application, a methodology for user evaluation study

was designed. To determine the primary user's subjective assessments of the application's usability the system usability scale (SUS) [3] was conducted. Resources in this research project were limited, so the evaluation study required volunteer study participants between 18 and 80 years of age. Fifteen people, twelve male and three female, aged between 25 and 50 years, answered the call for volunteers. Study participants were using the application in a usability lab for a limited period of time (one hour). At the beginning, all study participants were introduced to the personal-health application. Afterwards, every participant was conducting different tasks such as: measuring weight, measuring heart rate, answering medical questionnaires etc. At the end of the user evaluation study in the usability lab, study participants filled in SUS questionnaire.

The average SUS score personal-health application obtained is 68.2 out of 100. With the exception of two very bad ratings (7.5 and 12.5), almost all other ratings for the application are high above the average. Further SUS analysis is needed, which will provide reasons for the two extreme ratings. According to Bangor et al. [1], obtained SUS score means that study participants find personal-health application acceptable and good in terms of usability aspects.

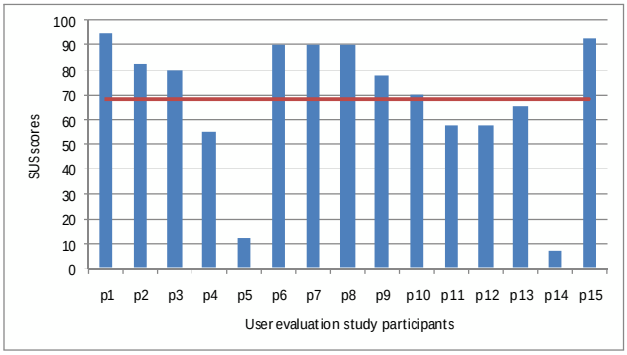

Figure 6: Individual and average SUS scores for the personal-health application

More detailed user evaluation study will be conducted in our future work. Study participants between 18 and 80 years of age from ten different households are going to be provided with the necessary equipment to use the personal-health application at their homes for longer period of time (one month). Special efforts will be made to achieve gender balance among the study participants. During the user evaluation, participants will perform different tasks using the application and rate the task difficulty of the most commonly used tasks [12]. Additionally, AttrakDiff method [10] will be used in order to find out how the attractiveness of the product is experienced, in terms of usability and appearance and whether optimization is necessary. Results from the detailed user evaluation study will be analyzed and used for further improvements of the personal-health application. Furthermore, the study results will be used to predict the user acceptance and adoption rate of the personal-health application.

CONCLUSIONS AND FUTURE WORK

The preliminary study of user experience shows that the personal-health telemonitoring application, presented in this paper, provides similar functionality as the dedicated personal-health systems. We plan to repeat the study with a larger target group of older adults and with an equal distribution by the gender. With additional usability evaluation methods we intend to additionally improve the application from user's point of view.

The application architecture, which is based on open programming and communication interfaces, is easily extendible. Further developments are therefore possible in the open-source community as well as in commercial service provisioning environments. This adequate support for PHS service deployment is of key importance. Successful service provisioning requires cooperation of personal-health system players, IPTV service providers and medical or/and health provisioning institutions. Dedicated, closed and proprietary solutions limit the possibility of such cooperation.

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Interactive TV User Interfaces: How Fast is Too Fast?

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ABSTRACT
The analysis, presented in this paper, is searching for an optimal speed of user interface for intractive TV navigation. Pleasant navigation technique for browsing through user interface usually incorporates scrolling. The latest set-top-boxes have enough processor power to support very fast scrolling not only for texts, but also photos and other elements. We designed and performed an experiment to measure optimal scrolling speed for different activities on user interface. We found out that optimal speed depends on type of navigation elements (text or graphics). The results of this study can improve the usability of horizontal and vertical navigation techniques in modern interactive TV navigation.

Keywords
User interface, navigation, scrolling, speed, interactive TV

INTRODUCTION
Navigation techniques provide an easy way for accessing large quantity of information on a limited screen space. Scrolling is a fundamental technique for moving in two-dimensional continual space. Scrolling user interface feels more alive, fluid and less abrupt.

In interactive TV and IPTV (Internet Protocol Television), users can navigate and select among vast of content (hundreds of TV channels, thousands of movies, pictures, etc.) therefore user experience is one of key issues for successful offering such services.

Many analysts [18] predict that the greatest barrier to the development of IPTV and interactive TV would be consumers. In the ever-changing technology environment, consumers must be convinced to adopt IPTV. Customers are questioning whether IPTV offers better features, such as content, price, user experience, and search or other unique applications.

Form the first introductions of interactive TV and IPTV the user experience has changed quite a lot.

First generations were base on simple set-top-boxes with low processor power, which were very limited in performance perspective. Typical architecture was based on client-server model, where client was typically implemented as simple limited web browser.

User interface was built as a web page with Java script functions were used for navigation. Consequently the user experience was rather low because of slow request-response model. End users had to wait while navigating through the menus.

The developments in set top box - STB chipsets with more powerful processors and entry of new players in this segment such as Intel have brought a shift in architecture of latest generation of IPTV and interactive TV solutions. Latest architecture typically uses fat client approach rather than thin client in the past. These implementations cache the necessary meta-data in the background. Consequently, user interface can provide fast and responsive user experience.

With this new architecture and highly performing hardware we have come to the point where set-top-boxes and user interface can work faster than the users can percept.

Figure 1: The problem of too fast scrolling on user interface. The user becomes disoriented when the menus and content are moving too fast. Source: Iskratel Innbox HD30 user interface with vertical navigation [12]

Because we at Iskratel are involved in development of such devices, we have met an important question for scrolling in user interfaces: how fast is too fast? How fast navigation on user interface at TV can ensure wide user segment with comfortable and acceptable user performance?

RELATED WORK

In the past, several studies already addressed similar problems related to perceived user experience.

Shin [19] explored the factors influencing the adoption of IPTV, and tested predicting user acceptance of IPTV. The analysis showed importance of perceived system quality. The higher the quality of content and responsiveness of the system, the more positive the attitude toward IPTV was confirmed. System quality is especially important in the context of IPTV, as many people become reluctant to use services when they experience frequent delays in response, disconnection, lack of access, or poor security [1]. Similarly, Lin and Lu [14] examined information quality, response time, and system accessibility. They argue that these three variables are useful predictors of perceived ease of use and perceived usefulness. Because response time and system accessibility, and other factors such as system reliability and security can be understood as attributes that explain system quality, information system quality can be comprehensively identified by system quality and information quality.

Scrolling is one of the most fundamental activities when interacting with computer, IPTV and interactive TV use. Igarashi & Hinckley [11] identified the problem that scrolling too fast results in the motion blurring. Motion blur can cause disorientation, and reduces the user's ability to determine whether they have reached their target. They analyzed scrolling issues in personal computer – PC environment for web browser, map viewer, image browser, dictionary and sound editor. Igarashi & Hinckley proposed speed-dependent automatic zooming (SDAZ) as a solution to the problem of motion blur when scrolling rapidly. SDAZ automatically alters the zoom level, based on scrolling speed. The document was smoothly zoomed out when the user's scrolling speed exceeds a predefined threshold.

Wallace et al. [20] analyzed scrolling and zooming for documents with text and graphic and determine metrics of visual flow to answer the question "how fast is too fast" on personal computer. Presented empirical results show maximum acceptable document speed at 2,68 pages/s and comfort speed at 1,52 pages/s. However they didn't measure any horizontal scrolling.

Human visual perception was analyzed by Card [7], Burr [5].They found that the human eye summates signals over a period of 120-125 ms. Visual accuracy can usually tolerate an image retinal velocity of up to 3 degrees per second [15]. However, the introduction of smooth-pursuit eye movement allows movement in excess of 9 deg/s [8], perhaps even up to 100 deg/s [3], as the tracking of the target reduces the retinal image velocity to a manageable level.

Based on previous results and through empirical study, Wallace et al. [20] recommended comfort scrolling speed for documents with pictures on PC as 1.52 pages per second.

The perspective tilt dynamics in zooming and scrolling techniques on mobile devices such as smart phones with tilt and accelerator sensors were the focus of research of Eslambolchilar & Murray-Smith [9]. The issues of small screen and specific navigation were closely observed and an optimized SDAZ model for mobile devices was proposed.

SCROLLING iTV USER NAVIGATION

Latest studies with qualitative methods confirm that most suitable navigation models and its unified user interface for application running on the TV, such as electronic program guide, are based on scrolling techniques [18]. This concept is also implemented in Iskratel's commercial set top box – media center Innbox HD30. Beside standard IPTV services such as live TV, video on demand, electronic program guide, personal video recording, more advanced services and applications are also supported e.g.: presence monitoring, messaging, call control, media exchange, recommendations, etc. Common to all those services is the usage of scrolling navigation. Since all necessary meta-data are locally cached, the system response is practically instant.

Implementation of User Interface

Figure 2: Main menu of Iskratel Innbox HD30 user interface [12]

User Interface is designed in two levels with rotating menus. On the main menu the user selects basic services and applications.

The second level is used for selecting the content (e.g. TV channels or movies in video store). For selecting TV channels, a vertical menu is displayed with seven neighboring listed channels. Each channel is accompanied with the following information displayed: channel name, number, logo and the name of current show. When pressing up or down button on the remote control, channels are scrolling up or down respectively. For video store, the

navigation pane is designed horizontally as presented at Figure 3.

Figure 3: Video store menu of Iskratel Innbox HD30 with horizontal navigation [12]

USABILITY STUDY

Wallace et al. defined metrics with *document speed* as the rate at which navigation through the information space is occurring. The speed is measured in units such as pages/second or lines/second. It is this value that it is desirable to maximize in order to acquire the target more rapidly. Alternative units that might be used include cm/s, pixels/s and degrees/s. These alternative units can be calculated as functions of screen resolution, physical screen size, and viewer distance from the screen.

In IPTV graphical user interface we are dealing with items such as channel lists, video on demand movie items or content titles in electronic program guide. Typically seven to eight content items are displayed on the screen at once. The metrics should be defined in clicks/second.

Nielsen [16] recommended user testing with 5 test users, to get the best result, especially when the user tests are an iterative process. This is shown in Figure 4. Also Hwang & Salvendy [10] confirmed that 10±2 participants is enough for usability evaluation.

In our research, 16 users participated in the test to achieve better statistical pattern.

Evaluation

The objective of the experiment was to obtain empirical data on the rate of information flow that humans find comfortable and tolerable when scrolling rapidly. Usability tests were conducted over a 2-month period in 2011.

Sixteen volunteer participants (13 male, 3 female) ageing from 19 to 57 years took part in the experiment. All participants had basic computer skills.

To assure proper test environment we set up a room with optimal lightning condition and viewing distance to TV set according to SMPTE (30 degree field) recommendation [22].

For evaluation we used graphical user interface based on Iskratel's media center product Innbox HD30. Navigation screens are presented on Figure 1 (vertical navigation) and Figure 3 (horizontal navigation).

Procedure

An important part of the experiment lay in the participants' understanding of the meaning of the task. Participants were individually advised to consider the task of scrolling vertically through TV channels and horizontally through video store menu with the goal of target acquisition in mind. They were instructed not to try and read all the channel data, but rather look for the locations of specific channel. They were asked to imagine they were scrolling through the menus with the intention of navigating to a known channel or movie.

The "most comfortable" speed was defined to be the speed at which they felt provided the optimal trade-off between acquiring the target quickly and maintaining an understanding of their location in the menu.

First we adjust 5 different vertical speeds in random order (presented in Table 1) and each participant was asked to rate the speed on a seven-point Likert scale [Figure 4], where too fast experience was rated one, and too slow experience was rated seven. Speeds were empirically chosen on pilot tests (from annoying slow, doubling the speed rates with focus on optimal speed, to much too fast). Those tests also indicated that different speeds for vertical and horizontal scrolling should be chosen.

vertical text speed (click/s)	2	7	17	31	62
horizontal graphic speed (click/s)	1	2	4	9	22

Table 1: Adjusted speeds for textual and graphical navigation.

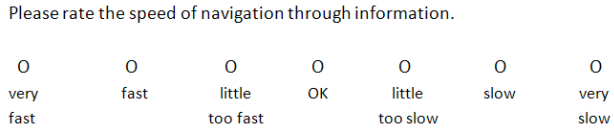

Figure 4: Likert questions for rating the speed for navigation

After evaluating 5 speeds participants were asked to choose optimal speed for them. The test was repeated for horizontal navigation again.

Results and discussion

Obtained results for vertical scrolling of TV channel list are presented in Figure5. Most of test participants marked 17 click/s as an appropriate speed. Other speeds were marked either too slow or too fast.

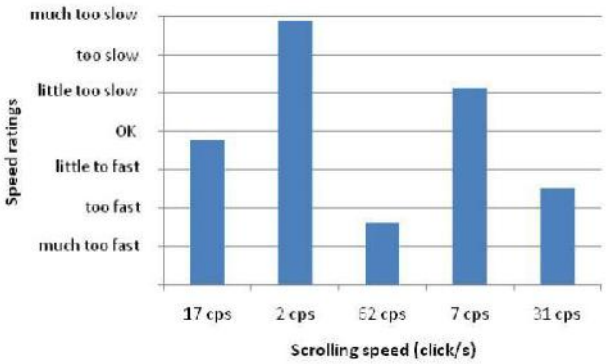

Figure 5: Results for vertical text scrolling in random order as were conducted on the test

Before participants moved to the next task, they were asked which speed (in sequence) they remembered as the most optimal for navigation. The answers of the question confirmed the previous results as shown in Figure 6.

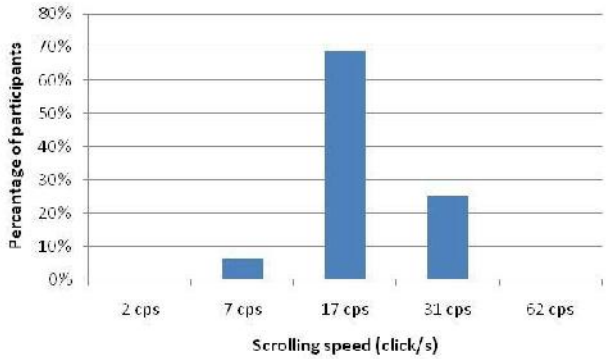

Figure 6: Optimal vertical text speed chosen by participants

Eleven participants selected vertical speed 17 click/s as most appropriate, three choose 31 click/s and one 7 click/s. We can conclude that on average 19.9 click/s (2.84 pages/s) is the optimal vertical scrolling speed for text based items (e.g. TV channel list). This result is higher compared with personal computer results (1.52 pages/s) of Wallace et al. [20]. We see main reasons in larger viewing distance, smaller screen view angle, nature of content – TV menus (less complex than document) and different type of navigation with remote control.

On the other hand ten participants selected horizontal speed 4 click/s as most appropriate, four choose 2 click/s and two 9 click/s. On average 4.1 click/s (0.59 pages/s) is the optimal scrolling speed for graphic based items such are movie posters in video on demand menu.

Summarized results shown in Figure 7 indicate that most optimal rated scrolling speeds for text and graphic based items.

We can convert these results into pages/s or screen time. For horizontal text based items the optimal screen time 350ms and for vertical graphic 1.71 s respectively. This differs from the results measured on other devices such as personal computer (900 ms [19]) and horizontal document scrolling.

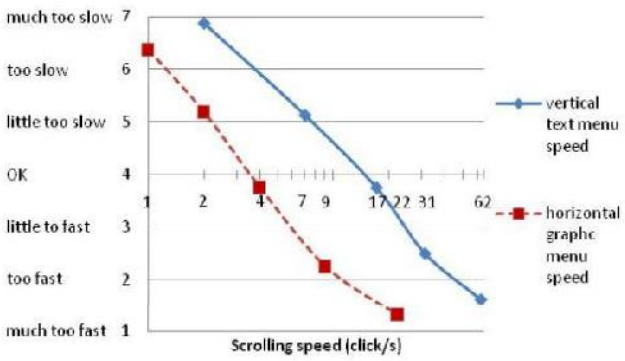

Figure 7: Scrolling speed rated by participants

The analysis of the results obtained from the conducted user evaluation study showed that we have to carefully select optimal navigation speeds in interactive TV user interface. Since it is strongly desirable that it is not too fast for any users we suggest that viewer speed should be less than 99% of people indicated as too fast.

CONCLUSION

The task of scrolling involves a rapid movement through the information space. This movement can cause blurring or disorientation if it occurs too rapidly. We conducted an evaluation to determine an optimal threshold value on the speed rate for Interactive TV navigation.

According to Kinchla et al. [13] human eye perception indicates no consistent difference in sensitivity of or vertical and horizontal movement. The only reason for different result is therefore in the content of a moving object. Text reading or recognition is also not highly dependent on vertical or horizontal movement [4].

We discovered that the optimal navigation speed depends mainly on wherever simple text or graphics is used in the navigation elements. Empirical results show's that optimal speeds in such case are up to 4.8 times slower. This is due to the fact that graphic recognition (e.g. movie poster) is much more complex and takes much more time than channel number - name or position recognition.

Optimal speed for TV navigation also differs from optimal speeds measured on other devices such as personal computers (document or browser scrolling) and mobile phones. Main reasons besides content are larger viewing distance, smaller screen view angle and type of navigation (remote control). We believe these result will help to improve future user interfaces of Interactive TV in terms of users experience and usability.

Future work

Future plans include testing the navigation speed in some other applications, such as electronic program guide or multimedia library. Although physiological attributes do not expect differences between for recognition at horizontal

and vertical scrolling [13], we plan to prepare in-depth statistical analysis and evaluate both vertical and horizontal graphic and text scrolling. More precise measurements of optimal speed will be conducted. Additional demographical data of participants (e.g. the amount of time user evaluation study participants spend on watching TV daily) will be correlated with results.

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Comparison of Two Ambient Intelligence Approaches to Elderly Care

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ABSTRACT
There is more and more elderly in the developed countries and not enough younger people to take care of them. We are presenting a semantic ambient media system for health-care monitoring to allow quality and safe living of elderly at their homes instead of needing them to go to nursing homes, which are overcrowded. Moreover, their offspring would not be overwhelmed with care for the elderly. The study illustrates two ambient intelligence approaches to the elderly care, both in the sense of four concepts of the semantic ambient media.

Keywords
Semantic ambient media DTW, AAL, elderly, health problems, motion capture.

INTRODUCTION
In the paper we are presenting the system as an example of the semantic ambient media for ambient assisted living (AAL). The reasons for such classification are:

- it is embedded in the natural environment of elderly,

- it uses AI approach to interpret the health status,

- it provides natural explanation of the hypothesis.

The motivation for this research study is increasing rate of the elderly population in the developed countries [16]. Elderly tend to lead an isolated life away from their offspring; however, they may fear being unable to obtain help if they are injured or ill. During the last decades, this fear has generated research attempts to find assistive technologies for making living of elderly people easier and independent. The aim of this study is to provide ambient assistive living services to allow quality and safe living of elderly at home instead of needing them to go to nursing homes, which are overcrowded. Moreover, their offspring or other relatives would not be overwhelmed with care for the elderly.

In this study, two approaches to an intelligent and ubiquitous care system to recognize a few of the most common and important health problems of the elderly, which can be detected by observing and analyzing the characteristics of their movement, are proposed. In the first approach we use medically defined attributes and support vector machine classification into five health states: healthy, with hemiplegia (usually the result of stroke), with Parkinson's disease, with pain in the leg and with pain in the back [12].

In the second approach we classify into same five health states using more general data mining approach. The movement of the user is captured with the motion capture system, which consists of the body-worn tags, whose coordinates are acquired by the sensors situated in the apartment. Output time series of coordinates are modeled with the proposed data mining approaches in order to recognize the specific health problem. In the case that health problem is recognized, the medical center is notified.

RELATED WORK
Review of the literature revealed, that motion capturing is usually done with inertial sensors [15, 2], computer vision and also with specific sensor for measurement of angle of joint deflection [13] or with electromyography [17]. For our study, the (infra-red) IR camera system with tags attached to the body [7] was used.

We do not address the recognition of activities of daily living such as walking, sitting, lying, etc. and detection of falling, which has already been addressed [3, 6, 9] but more challenging recognition of health problems based on motion data.

Using similar motion capture system as in our approach, the automatic distinguishing between health problems such as hemiplegia and diplegia is presented [8]. However, much more common approach to recognition of health problems is capturing of movement which is later examined by medical experts by hand [13, 4, 11). Such approach has major drawback in comparison to ours,

because it needs constant observation from the medical professionals.

The paper [10] presented a review of assistive technologies for elderly care. The first technology consists of a set of alarm systems installed at person's homes. A system includes a device in the form of mobile phone, pendant or chainlet that has an alarm button. They are used to alert and communicate with the warden. When the warden is not available, the alert is sent to the control centre. However, such devices are efficient only if the person recognizes an emergency and has the physical and mental capacity to press the alarm button.

The second technology presented in [10] is video-monitoring. The audio-video communication is done in real-time over the ordinary telephone line. The video can be viewed on monitor or domestic television. The problems of the presented solution are ethical issues, since the elderly users don't want to be monitored by video [3]. Moreover, such approach requires constant attention of the emergency center.

The third technology in [10] is based on health monitors. The health monitor is worn on the wrist and continuously monitors pulse, skin temperature and movement. At the beginning of the system usage, the pattern for the user is learned. Afterwards, the deviations are detected and alarms are sent to the emergency centre. Such system detects collapses, faints, blackouts etc.

Another presented technology is the group of fall detectors. They measure the accelerations of the person with the tags worn around the waist or the upper chest. If the accelerations exceed a threshold during a time period, an alarm is raised and sent to the community alarm service. Bourke et al. [1] present the acceleration data produced during the activities of daily living and during the person falls. The data was acquired by monitoring young subjects performing simulated falls. In addition, elderly people have performed activities of daily living. By defining the appropriate threshold they can distinguish between the accelerations during the falls and the accelerations produced during normal activities of daily living. Therefore, the accelerometers with the threshold can be used for monitoring elderly people and recognizing falls. However, threshold based algorithms produce mistakes, for instance fast standing up from/sitting down on the chair could result in crossing the threshold which is erroneously recognized as a fall.

In [14], architecture of a system that enables the control of the users at their homes is described. It consists of three levels. The first level represents the ill persons at their homes equipped with communication and measurement devices. The second level represents information and communication technology that enables the communication with the main server. The last level represents the telemedicine center including duty operator, doctors and technical support; the centre for the implementation of direct assistance at home; and team of experts for implementing telemedicine services. Such system does not provide any automatic detection of an unusual behavior but instead requires constant observation by the medical center.

Williams et al. [18] have showed that the ability to perform daily activities is decreased for the people that have fallen several times and that the decrease can be detected using accelerometers. They have tested elderly people that have not fallen yet and those that have fallen several times. All of them were asked to perform a predefined scenario including sentence writing, objects picking etc. The accelerations differ significantly between the two groups of people during the test.

The aim of our paper is to present an application of semantic ambient media for ambient assisted living. The presented application is an automatic classifier able to support autonomous living of elderly by detecting health problems recognizable through the movement.

SEMANTIC AMBIENT MEDIA APPROACHES TO AMBIENT ASSISTED LIVING

The concepts of the semantic ambient media

For the semantic ambient media, four concepts are very important:

- Business
- Content & Media
- Interactive Design & Experience
- Concepts & Models

We will present our proposed system through these concepts.

Business

- Elderly care at the institutions is very expensive and this study provides cheaper solution. Insurance companies could be interested in this solution.
- Work is part of the research project with plan to finish with the prototype.
- Collaborating company *Špica International* is interested in developing and selling the final product from research results.

Content & Media

- What is 'content' and how can it be presented in the age of 'ubiquitous' and 'pervasive'? How to present, select, compose and generate ambient content?
  - It is information of the health state of the elderly, composed through the automatic interpretation of their motion patterns

and presented in the form of the system's explanation.

- How to manage and re-use ambient content in specific application scenarios?
  - The models for the interpretation of the health status (content), trained on the initial group of elderly with specific health problems is used on the new elderly users, who are healthy when starting using the system, for the interpretation of their potential health problems.

Interactive Design & Experience

- How can collaborative or audience participatory content be supported?
  - Audience participatory content is supported through the possibility of the physician to see/hear the alarm and explanation of the reasons for the alarm (including live kinematic visualization of user's movement).

Concepts & models

- How can sensor data be interpreted and intelligently mined?
  - Sensor data from the motion capture system are modeled with data mining methods.
- How can existing media such as TV, be extended by ambient media?
  - Existing media can be used for visualization of the interpreted health states.

Targeted activities and health problems for detection

The research is comparing the specific and the more general approach to recognition of health problems. It classifies walking patterns into five different health states; one healthy and four unhealthy. All the health problems we are recognizing were suggested by the collaborating medical expert on the basis of occurrence in the elderly aged over 65, the medical significance and the feasibility of their recognition from movements.

The following four health problems were chosen as the most appropriate [4]:

- Parkinson's disease,
- Hemiplegia,
- Pain in the leg and
- Pain in the back.

Classification was done using:

1) Medically defined attributes and SVM classifier and
2) the k-nearest neighbor machine learning algorithm and dynamic time warping for the similarity measure.

Features for data mining

The recordings consisted of the position coordinates for the 12 tags worn on the shoulders, the elbows, the wrists, the hips, the knees and the ankles, sampled with 10 Hz. The tag coordinates were acquired with a Smart IR motion-capture system with a 0.5-mm standard deviation of noise. From the motion capture system we get position of each tag in x-y-z coordinates.

In the first (specific) approach using medically defined attributes attributes, such as average angle of the right elbow, the quotient between the maximum angle of the left knee and the maximum angle of the right knee and difference between the maximum and minimum height of the left shoulder, were defined with help of a medical expert.

We compared the specific approach with the general approach where movements were represented with more general attributes. The advantage of latter approach is that we can add some new health state(s) to be recognized using the same algorithm and attributes.

Considering the abovementioned, in the general approach we designed attributes as the angles between adjacent body parts:

- left and right shoulder angles with respect to the upper torso at the time t
- left and right hip angles with respect to the lower torso
- the angle between the lower and upper torso
- left and right elbow angles, left and right knee angles.

Dynamic Time Warping

We will present dynamic time warping (DTW) as a robust technique to measure the "distance" between two time series [7]. Dynamic Time Warping aligns two time series in the way some distance measure is minimized (usually Euclidean distance is used). Optimal alignment (minimum distance warp path) is obtained by allowing assignment of multiple successive values of one time series to a single value of the other time series and therefore DTW can also be calculated on time series of different lengths.

The DTW algorithm commonly described in the literature is suitable to align one-dimensional time series. This work employed a modification of the DTW which makes it suitable for multidimensional classification.

First, each time point of the captured time series consisting of the positions of the 12 tags coming out of motion

capture system is transformed into angle attribute space, as defined in this paper. The classification will then be performed in the transformed space.

To align an input recording with a template recording (on which the classifier was trained), we first have to compute the matrix of local distances, *d(i,j)*, in which each element *(i, j)* represents the local distance between the *i*-th time point of the template and the input at the time *j*. Let C_{js} be a generic feature vector element relative to a template recording, and Q_{is} be the feature vector element relative to a new input recording to recognize, where $1 \le s \le N$ is the considered feature.

For the definition of the local distance the Euclidean distance was used, defined as follows:

$$d_{Euc} = \sum_{s=1}^{N} (C_{js} - Q_{is})$$

Given the matrix of local distances a matrix of global distances *D* is built. The value of the minimum global distance for the complete alignment of DTW procedure, i.e. the final algorithm output, is found in the last column and row, $D(T_r, T_r)$. The optimal alignment can also be efficiently found by back tracing through the matrix: the alignment path starts from $D(T_r, T_r)$, then it proceeds, at each step, by selecting the cell which contains the minimum cumulative distance, between those cells consented by the alignment path constraints, until *D(1, 1)* is reached.

Usability

Considering the usability perspective, it is very important to obtain an explanation for the interpreted health state. Thus we developed a control-panel prototype, which is intended to be used by physicians (shown in Figure 1).

When a health problem is recognized, the red alarm button appears in the upper-left-hand corner of the screen with a description of the recognized case for the relatives and for the medical center with the control panel.

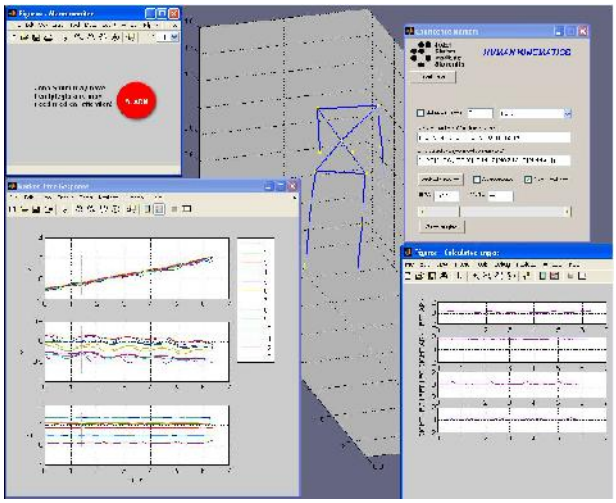

Figure 1: Explanation of automatic interpretation for the physician

RESULTS

In the first (specific) approach, for each recording attributes were calculated and SVM classifier was used to classify them into five health states.

In the second (general) approach, the DTW algorithm was used to stretch and compress an input time series in order to minimize a suitably-chosen distance measure from a given template. We used a nearest neighbor classifier based on this distance measure to design the algorithm as a health state classifier.

The classification process is considering one input time series, comparing it with the whole set of templates, computing the minimum global distance for each alignment and assuming that the input recording is in the same class of the template with which the alignment gives the smallest minimum global distance (analogous to instance-based learning).

The 10-fold cross-validation for 5-nearest neighbor classifier resulted in classification accuracy of 97.9% and 97.6% for the specific and the general approach, respectively. Thus, the performance of both approaches is similar.

More detailed results are off the scope of this paper; however we will just mention them in few sentences. They show that in both proposed approaches false positives/negatives are very rare, i.e., they would not cause much unnecessary ambulance costs. Since the method accurately classified most true health problems, it represents high confidence and safety for the potential use in elderly care.

CONCLUSION

We presented an application of semantic ambient media system for health-care monitoring. It allows prolonging of

the independent living of elderly in their own homes. The study illustrates two ambient intelligence approaches to the elderly care, both in the sense of four-topic concept of the semantic ambient media. Both approaches classify movement of elderly person into five health states; one healthy and four unhealthy. Even though the second approach is more general and can be used also to classify other types of activities or health problems, it still achieves high classification accuracies, similar to the more specific approach.

The system is example of the semantic ambient media for AAL because it is embedded in the natural environment of elderly, it uses artificial-intelligence algorithms to interpret the health status and provides natural explanation of the hypothesis.

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Coping with the Dynamics of Open, Social Media on Mobile Devices with Mobile Facets

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ABSTRACT

When traveling to a foreign city or wanting to know what is happening in one's home area, users today often search and explore different social media platforms. In order to provide different social media sources in an integrated manner on a mobile device, we have developed Mobile Facets. Mobile Facets allows for the faceted, interactive search and exploration of social media on a touchscreen mobile phone. The social media is queried live from different data sources and professional content sources like DBpedia, a Semantic Web version of Wikipedia, the event directories Eventful and Upcoming, geo-located Flickr photos, and GeoNames. Mobile Facets provides an integrated retrieval and interactive exploration of resources from these social media sources such as places, persons, organizations, and events. One does not know in advance how many facets the application will receive from such sources in a specific contextual situation and how many data items for the facets will be provided. Thus, the user interface of Mobile Facets is to be designed to cope with this dynamics of social media.

Keywords

Dynamics of Social Media, Mobile Computing

1. INTRODUCTION

The interaction paradigm of faceted search and exploration has been well studied on desktop computers in the last decades [3, 2, 4, 6, 11]. Facets divide a data space along its categories. By selecting facets, the result set is constantly narrowed down. This allows the users to easily handle a large amount of data.

When transferring the interaction paradigm of faceted search and exploration to the mobile world, one has to deal with additional problems due to limited interaction possibilities and smaller display size. These limitations are opposed to the complexity and dynamics of the facets and data items (resources) that are retrieved from the open social media data sources and that need to be visualized and explored. For example, in the social web, one wants to retrieve information about a city and its sights from Wikipedia[1], see photos related to the sights on Flickr[2], and explore events happening in the city from event directories like Upcoming[3] and Eventful[4]. These data sources are open as they offer besides a web-based user interface also access by some publicly available application programming interfaces, e.g., REST in the cases of Flickr and Upcoming. Other data sources have been translated into the Resource Description Framework (RDF)[5] format of the Semantic Web. For example, a Semantic Web version of Wikipedia is provided by DBpedia [1] and made publicly available through a SPARQL[6] endpoint. As the data is retrieved live, we do not know in advance the number and type of facets and data items. This requires an even smarter user interface and intuitive use of facets than on desktop computers. This is a problem, as providing an intuitive and easy to use mobile user interface for faceted search and exploration is hard.

In this paper, we present Mobile Facets for the interactive, faceted search and exploration of different, integrated social media sources on a touchscreen mobile phone. The Mobile Facets application allows for retrieving entities such as places, persons, organizations, and events from an integration of DBpedia, Eventful, Upcoming, and geo-located Flickr photos and professional content from GeoNames[7]. In order to cope with the dynamics of the resources retrieved live from the open social media data sources, the Mobile Facets application provides a flexible mobile user interface based on facets. The principle idea is to start with a small number of predefined high-level facets, namely Places, Persons, Organizations, and Events, and to fill them dynamically with the facets and resources retrieved live from the social media data sources.

2. ITERATIVE PROTOTYPE DESIGN

Starting with a paper-based mock-up prototype, we have created and continuously improved a running prototype that a small group of five users have tried out on a touchscreen mobile phone. The age of the users is between 26 to 35 years (avg.=29.75, SD=4.11). The experience in using mobile phones in the group is between good to very good. In addition, two users are experts on user interfaces. We have developed our Mobile Facets application under Google's Android operating system and tested it on a Motorola Milestone XT720.

[1] http://www.wikipedia.org/
[2] http://www.flickr.com/
[3] http://www.upcoming.org/
[4] http://www.eventful.org/
[5] http://www.w3.org/TR/REC-rdf-syntax/
[6] http://www.w3.org/TR/rdf-sparql-query/
[7] http://www.geonames.org/

In the following, two of the most important design decisions are discussed in more detail. These are designing the users' interaction for searching and exploring the open social media data using facets and visualizing selected facets.

2.1 Search and Exploration Using Facets

Goal of the search and exploration using facets is to enable the users to find interesting places, persons, organizations, and events in their vicinity through a poly-hierarchy of facets. When navigating in multiple facet hierarchies, users should still be able to keep track of the choices they made and should not feel lost. To achieve this, we have created three different design variants for our mobile search and exploration using facets. In all variants, the users start with the high-level facets Places, Persons, Organizations, and Events.

In the first design variant shown in Figure 1a, the user clicks on a high level facet such as Places. By this, the user navigates into the facet hierarchy and the sub-facets of Places are shown such as Populated Places, Area, City, and so on. For each facet, the number of results is shown such that the user knows which sub-facets are more populated than others. In the second design variant shown in Figure 1b, the facets are selected by means of pull-down menus. First, a high-level facet is selected like Places. Then, a pull-down menu appears showing the sub-facets of the previously selected facet. The users can select a sub-facet from the list to further refine the result list. The last design variant divides the screen into several smaller areas for facet selection and exploration. The user starts at the top-left corner to choose from a high-level facet like Places. Subsequently, the right hand side is filled with the sub-facets and the users can choose one from it like Historic Places. The result list is then further narrowed down in the bottom left part of the screen.

The user group found it in principle useful to navigate by means of lists of facets. This was seen as a strong advantage of the first design variant by most users. But the users mentioned that the font should be large. It was also mentioned that it might be cumbersome to navigate through multiple hierarchies of facets which may contain large lists of sub-facets. Advantage of the second approach is that the users see which (sub-)facets have been selected. However, the users disliked that the drop-down menus are dynamically added to the screen. In addition, selecting items from the drop-down menus was considered cumbersome. In the third design variant, again the users can keep track of the interactions, i.e., the facets they have selected. However, the problem is that the available space of the screen is limited and thus the interaction with the mobile phone is difficult.

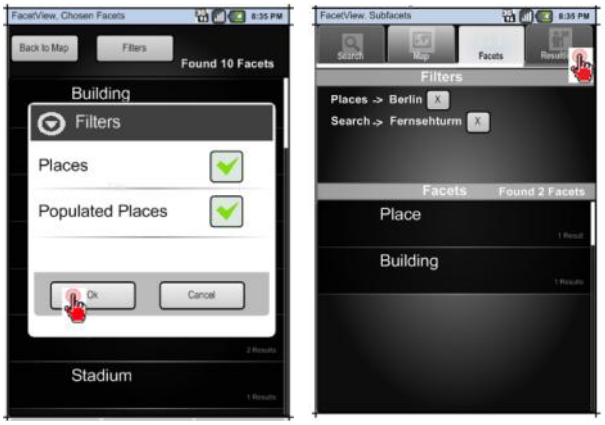
From the three design variants the best rated was the first one. The only disadvantage with the first design variant is that the users do not see which facets were previously selected.

2.2 Visualizing Selected Facets

In order to support users in keeping track of the facets they have selected, the current state of the system needs to be shown to them appropriately. The user group has been presented two different design variants A and B showing how the selected facets can be visualized.

The design variant A is created such that it can be applied together with all three design variants for faceted search and exploration as presented in the previous section. To see the currently selected facets, the users can click on the "Filter" button shown in the top of the screenshots of Figure 1a to 1c. Please note that at that time of the system design, the term "filter" was used to show the currently selected facets. During the iterative design, we have asked the subjects if they would prefer the alternative term "facet" instead. As the latter was considered more appropriate (only one subject disagreed), we use the term facet in the final prototype. Subsequently, a menu pops up depicting the currently selected facets as shown in Figure 2a. The selected facets are, e.g., Places and its sub-facet Populated Places. To unselect a facet, the checkboxes at the right hand side can be used. When sub-facets such as Populated Places are removed, the system falls back to the higher-level facet, in this case Places. However, when unselecting the facet Places, also the facet Populated Places is unselected as it is a sub-facet of it.

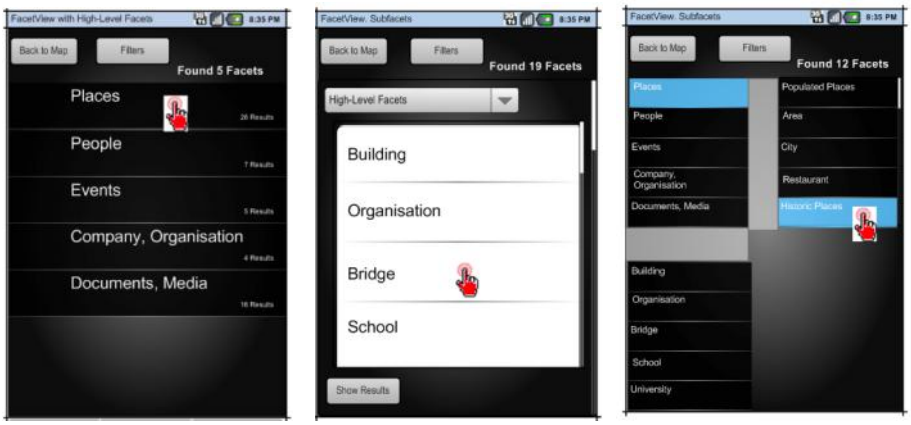
In the design variant B depicted in Figure 2b, the currently selected facets are shown together with the search and exploration via facets as depicted in Figure 1a. The user has selected the high-level facet Places and has further narrowed down the result list by choosing the sub-facet Berlin. We have also added a keyword search, in this example a specific kind of sights, namely transmission towers (Search → Fernsehturm). The facets can be unselected, by clicking on the "X" button on the right hand side of it.



(a) Variant A (b) Variant B

Figure 2: Different Variants for Visualizing Selected Facets

In the design variant A, it was clear how to unselect facets. However, the users did not found it intuitive that the facet Populated Places is a sub-facet of Places. Although a keyword-based search like for the transmission towers was appreciated in general, integrating it into the selected facets as shown in the design variant B (Figure 2b) was not considered useful. In general, however, the design variant B was considered more intuitive and chosen for the final prototype.



(a) Variant 1 (b) Variant 2 (c) Variant 3

Figure 1: Different Variants for Search and Exploration Using Facets

3. FINAL IMPLEMENTATION OF THE MOBILE FACETS PROTOTYPE

We present in this section the final design and functionality of the Mobile Facets prototype along the tabs it provides, namely faceted search and exploration, map view, result list view, and photo view. Finally, we present the details view of resources. The users can switch arbitrarily between the tabs by clicking on the corresponding icon at the top of the application.

3.1 Tab 1: Faceted Search and Exploration

When starting the Mobile Facets application, the first tab for faceted search and exploration is shown to the user as depicted in Figure 3a. The screen is divided into two parts: In the upper area, the facets and sub-facets selected by the user are shown. In the example in Figure 3a, the user has selected the facets Educational Institution and Museums in Berlin. The resulting resources are all organizations of educational background merged with all places that are museums in the city of Berlin. By clicking on the cross next to the facets, the entire facet is removed. In addition, the user can remove all currently selected facets or add a new facet using the "+" icon. In order to avoid empty result lists when searching and exploring using facets, the number of items retrieved, i.e., the number of sub-facets or instances is shown under the facets. For example, there are eleven Museums in Berlin.

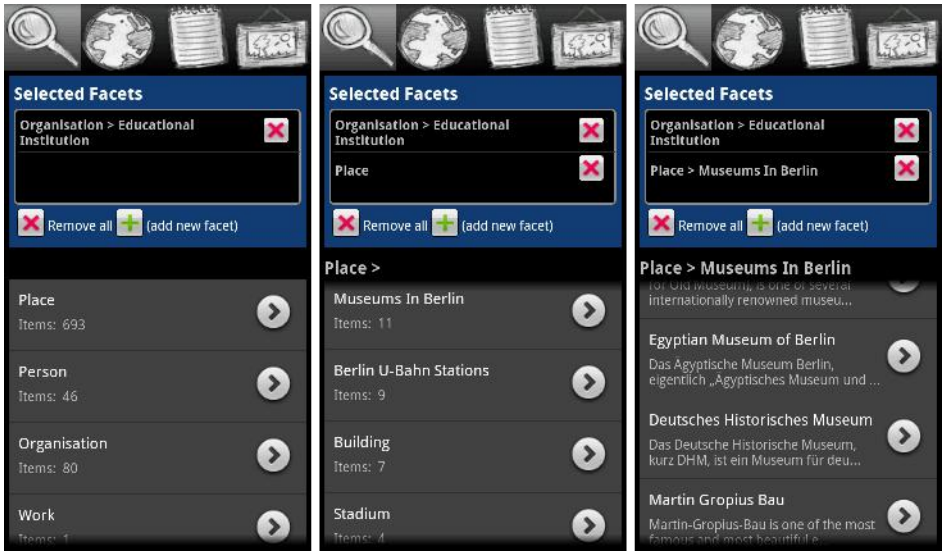
The lower area of Figure 3a shows the available facets and allows the users to select and explore the information space using facets. The facets are initially filled when starting the application or by executing a "What's around me?" query from the applications menu (no screenshot provided). One starts with selecting a high-level facet and narrows down the result set using sub-facets. Figure 3a (left) shows the high-level facets Places, Persons, Organizations, and Events and the selected facet Organisation → Educational Institution. The user selects the high-level facet Place. Subsequently, the sub-facets of Place in Berlin such as Museums in Berlin, Berlin U-Bahn Stations, and others are shown as depicted in Figure 3a (middle). The user clicks on the facet Museums in Berlin and the instances of this facet are shown as depicted in Figure 3a (right). By clicking on one of the instances, the details of this resource are shown as described in Section 3.5.

3.2 Tab 2: Map View

Once the users have selected appropriate facets using the tab described in the previous section, they can visualize the results on a map. To this end, the users click on the map view tab, which allows standard map-based interaction such as zooming and panning as depicted in Figure 3b. The map view shows all search results that have a geo-location like places and organizations. When clicking on a point of interest, its details are shown as described in Section 3.5. The blue stars shown on the map are events, i.e., point of interests that are of interest during a specific period of time like a concert or an exhibition. The Mobile Facets application provides a novel time-slider widget [7] to browse through time, which is located at the bottom of Figure 3b. The events are rendered depending on the temporal distance to the currently selected date of the time-slider widget. Events happening today are shown in shaded blue-red whereas events happening up to 30 days in the future are more and more lightened up. This provides the users immediate feedback when events are happening while operating the time-slider widget.

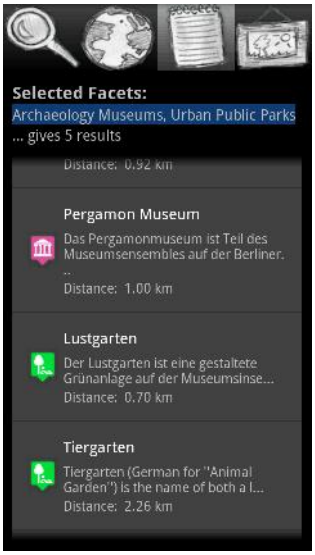
3.3 Tab 3: Result List View

Besides a faceted search and exploration and map view of the results, there is also a plain list view of matching resources as shown in Figure 3c. It contains all resources of the currently selected facets as described in Section 3.1. The resources shown in the result list view can be any instances of the high-level facets or its sub-facets. In the example, the facets Archaeology Museums and Urban Public Parks in Berlin are selected and its five results are shown in the list. The users can click on the results, which again opens the details view.

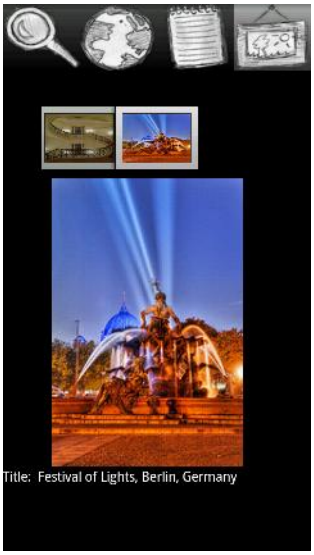


(a) Faceted Search and Exploration View: High-level facets, Sub-facets, and Instances

(b) Map View with POIs and Events



(c) Result List View Showing Places in Berlin



(d) Photo View

(e) Details View

Figure 3: Mobile Facets Application

3.4 Tab 4: Photo View

The photo view depicted in Figure 3d is the last tab in the Mobile Facets application and shows images from Flickr that have been taken in the vicinity. A gallery of photos is shown at the top. Users can scroll through it and click on images they like to see in larger resolution.

3.5 Details View

The details view of a resource can be opened from all tabs of the Mobile Facets application. Depending on the type of resource, the details view shows different information: For DBpedia resources, i.e., places, organizations, and persons described on Wikipedia, the details view provides a title, thumbnail (if available), link to the article's web page, abstract, and others. As an example, Figure 3e shows the details of an event with Germany's entertainer Harald Schmidt. The users can click on the photo icon to switch to the photo view. For resources with a location, also an icon to switch to the map view is provided. For event resources, the details view shows the event category, start date, end date, address of the venue, and the event description (no screenshot provided).

4. DATA INTEGRATION

As data corpus, we use publicly available sources of social media data and a geo-location website, namely DBpedia, the event directories Eventful and Upcoming, geo-located Flickr photos, and content from GeoNames. The data is queried and integrated live from the data sources. Thus, we cannot make any assumptions about which facets and how many data resources the Mobile Facets application receives in a specific contextual situation. The data is social as it is generated by users, but with GeoNames, Eventful, and Upcoming it also contains professional data.

The data infrastructure of Mobile Facets is designed such that it allows for an easy integration of further open (social media) data sources available via, e.g., REST interface or SPARQL endpoint. However, at the moment, the abstract categories of the social media data sources are manually associated with the high-level facets of Mobile Facets, namely Places, Persons, Organizations, and Events. In a future extension of Mobile Facets, we plan to replace this initial hardwiring of the social media data sources and the high-level facets by a dynamic mapping.

5. RELATED WORK

FaThumb is a keypad-driven application for mobile faceted search and exploration [5]. The search result is narrowed down iteratively by using the number keypad of the mobile phone. Due to the time when FaThumb has been developed, it does not provide a GPS-based map view or a rich media view, e.g., for showing pictures of the selected items.

With mSpace Mobile, we find a pen-based mobile application for faceted search and exploration of location-based information [9, 10]. It is designed for personal digital assistants running Microsoft Windows Mobile. The user interface is divided into tiles. Each tile shows one aspect of the information space such as a list of points of interests, a map, or metadata. The upper tiles serve as navigation within the available facets. By selecting them, the content of the lower tiles changes such as points of interests on the map and information about the selected facet.

The Mobile Cultural Heritage Guide [8] is a tourist guide application for Amsterdam providing an augmented reality view. Users can explore the artists that have lived and worked in the city and have a look at the places today from the perspective of the painters in former times. The application is specifically designed for the cultural heritage domain and does not provide a generic interface for mobile faceted search and exploration. Thus, the Mobile Cultural Heritage Guide does not provide a flexible user interface to cope with, e.g., a dynamically filled list of sub-facets where the number of sub-facets is not known in advance or might contain many entries.

In contrast to the prior work, we present in this paper a generic user interface for faceted search and exploration in a large, multi-dimensional information space of social media data on a touchscreen mobile phone. We do not assume to know in advance what kind of facets the users will receive and how many facets and resources one finds at a given user location. This is due to the fact that we query the social media data sources live and are not using any predefined, closed data set.

6. CONCLUSIONS

In this paper, we have presented Mobile Facets, a mobile application for faceted search and exploration of a large data set of open social media data on touchscreen mobile phones. The data is retrieved live from different sources allowing to apply Mobile Facets at any location in the world covered by Wikipedia, GeoNames, Eventful, Upcoming, and Flickr. The design of an application for faceted search and exploration on a mobile device was significantly harder and more complex than for a desktop computer. This is due to the fact that the interaction possibilities with the mobile device are limited and the display size is smaller. In addition, the Mobile Facets application has to cope with the dynamics of the data, i.e., the fact that one does not know in advance the number and type of facets and resources retrieved live from the integrated open social media sources.

Acknowledgments.

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Either Google or your friends, which of them do you believe? : Mobile Social Networking Search

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ABSTRACT
When we arrive at a strange place and instantly need to gain useful information at where is far from desktop computer, there are two solutions either sending SMS to our friends who live around there or searching via mobile web browser. Although 3G phone makes possible to search via mobile web browser it has a number of constraints such as tiny display, input problem, service price etc. Further web browsing search requires procedural delay which has to select among hyperlinks. In contrast SMS is not only all-pervasive use to mobile users, but also receive the mostly instant feedback from sendee. Fortunately it has well constructed social networking service on the Internet, such as Twitter, Facebook, etc. The conceptual model of social networking search is to build human-knowledge network using these well-structured SNS, rather than web searching engine.
This paper is to examine which is the effective ways for obtaining information through mobile phone between enquiring to neighbor as collective intelligence and the existing search engine. Furthermore it presents how to realise the social networking search on the mobile phone with adequate regime.

Keywords
Mobile Search, Social Networking Service, SMS, Collective Intelligence

INTRODUCTION
Thousands of millions people google everyday to search for information what they need. Although most of these searches are conducted from a personal computer others need to find information when they are far from a desktop. Thanks to mobile technology it is possible to search the desired information via mobile phone which has 3G functionality with web browser. However all users have not 3G phone. So far web browsing on mobile phone is not common use, especially developing countries.
Even though someone uses 3G phone such as iPhone it is hard to obtain the satisfied information from web searching as fast as he/she wants. Hence some portal such as Google provides SMS for their users, which contains the requested information. It can assume that SMS is faster interaction than web searching whatsoever it use mobile phone or desktop. From this assumption this paper presents the possibility for new mobile searching method using social networking service rather than mobile browser.

LITERATURE REVIEW
Today mobile Internet market is rapidly growing up and deeply penetrating into our daily life. According the report SMS text messaging is the most widely used data application on the planet, with 2.4 billion active users, or 74 percent of all mobile phone subscribers sending and receiving text messages on their phones. Whatsoever mobile phone is 2G or 3G SMS functionality has been widely used by users. The advent of 3G mobile leads to adopt mobile Internet service using web browsers such as Google, Android, Safari, i-mode etc.
Approximately 40 percent of the population enjoy access to the Internet via mobile phones in Japan, where user needs have driven developments of the mobile Internet such as 'i-mode'. The number of Internet-enabled mobile phones is over 54 million, which is 77 percent of the total mobile phones as of June in 2002 [1].
As below mention, while mobile Internet use is gradually increasing, SMS still has relative attractive position from a point of pricing which is a crucial factor to users.

World Mobile Statistics
In 2009 half a billion worldwide people accessed mobile Internet. According to the mobiThinking compendium over 85 percent of new handsets will be accessible the mobile web by 2011. Currently the US and EU use an Internet-ready phone, not smartphone. It means that 3G phone is not a unique solution to access the mobile web. Almost one in five global mobile subscribers has access to high-speed mobile Internet services whether he/she has a smartphone or not. International Telecommunication Union reports the number of mobile subscribers approaches 5.3 billion in 2010 which accounts for 77 percent of the world population. Figure 1 illustrates the number of global mobile subscribers in 2010.

Key Global Telecom Indicators for the World Telecommunication Service Sector in 2010									
	Global	Developed nations	Developing nations	Africa	Arab States	Asia & Pacific	CIS	Europe	The Americas
Mobile cellular subscriptions (millions)	5,282	1,436	3,846	333	282	2,649	364	741	880
Per 100 people	76.2 %	116.1 %	67.6 %	41.4%	79.4%	67.8 %	131.5%	120.0%	94.1 %
Mobile broadband subscriptions (millions)	940	631	309	29	34	278	72	286	226
Per 100 people	13.6 %	51.1%	5.4%	3.6 %	9.7 %	7.1%	25.9 %	46.3 %	24.2 %

Fig. 1 World mobile subscribers from International Telecommunication Union (October 2010)

Above stat generally implies the mobile cellular subscribers lead over the mobile broadband service in spite of the fast growth of 3G. Developing countries show lower mobile broadband penetration than developed nations. The rate of mobile broadband subscription of cellular owners in developing nations is only 8 percent rather than 43 percent in developed countries. Arab states, Asia and Pacific countries, and Africa demonstrate less than 12 percent. It implies that the developing countries hesitate to invest the mobile broadband infrastructure on account of the national cost.

Regardless of the mobile Internet's forte text messaging service is universalised all over the world even developing countries. In 2010 over 6.1 trillion messages had sent all around the world through cellular phones. It is within bounds to say that SMS is still king of mobile messaging. Despite the stunning growth of 3G penetration such as e-mail, twitter, web browsing SMS is preferred by global mobile users and predicted to exceed 10 trillion in 2013.

Use of SMS has not been dented by the popularity of other mobile media such as mobile web, email, applications and mobile social networking services. This staying power and a pervasive tool to send messages are the reason why SMS is still No 1 in mobile marketplace.

Mobile Internet Price versus SMS Price

There are two ways that mobile Internet is priced. Mobile users can utilise 2G networks to access the Internet much like one would use a fixed-line telephone network to dial up. Drawbacks with this approach are slow speeds (e.g., 9.6 kbps for GSM) and much higher prices paid for mobile service compared to fixed-line telephone. The second option for mobile Internet pricing revolves around volume-based schemes operators have introduced with the launching of 2.5 and 3G high-speed networks. Operators generally offer a casual, pay-as-you-go price or different monthly subscription packages based on the volume of data included.

Available data point to growing non-voice mobile usage. Mobile telephone users in the UK sent over 50 million text messages in December 2002, compared to less than 10 million for the same month 3 years earlier.

The growth of mobile Internet may impose a need for regulatory intervention to ensure interoperability of mobile data networks and open access to mobile portals. The use of mobile Internet also impacts the evolution of the information society as a growing number of citizens access web services from mobile telephones. Mobile Internet access could also have important ramifications for numerous countries, particularly many developing nations where there are now more mobile than fixed subscribers.

Even though it is driving the unlimited data regime in the US and Japan, the EU is still holding up progress due to the lack of availability.

Collective Intelligence

Collective intelligence has been one of key themes of Web 2.0 coined by Thimothy O'Reilly. It is largely accepted that more generally crowd sourcing such as Wikipedia representatively, is a novel and efficient way to resolve complex tasks and problems on the network society. Collective intelligence is also very promising way to reduce rising R&D costs [2].

Collective intelligence or swarming is often referred to large voluntary group and its collaboration, for instance to produce software, information such as Wikipedia or problem solution. In such group the participation, the methods and the results are opened, shared and accessible to all, including to those who are not participating [3].

According to Tapscott and Williams, collective intelligence is mass collaboration. In order for this concept to happen, four principles need to exist. These are openness, peering, sharing and acting globally. Openness allows others to share ideas and discussions rather than before a few decade when people and companies even government are reluctant to open their ideas, intellectual property and documents. Peering is a form of horizontal organization with the capacity to create information technology and physical products. Participants in this form of collective intelligence have different motivations for contributing, but the results achieved are for the improvement of a product or service.

In terms of sharing it has been a controversial issue for a long time and so far. Some has allowed them to expand their market and bring out products faster. The advancements in communication technology have prompted the rise of global companies, or e-Commerce that has allowed individuals to set up businesses at low to

almost no overhead costs. The influence of the Internet is widespread. Therefore a globally integrated company would have no geographical boundaries but global connections allowing them to gain access to new markets, ideas and technology [2].

Social Networking Service

Social networking service on the Internet can be defined as Web-based services which allow individuals to compose a user's profile, a list of users with whom they share a connection, and review their list of contracts [4]. In 1980s the bulletin board system (BBS) is considered as the earliest online social network that allowed users post public messages, send and receive private messages, and share resources. It is not a new generation of social networking service until the form of Friendster.com was appeared in 2002. Friendster uses a model of social networking which allows users to invite friends and acquaintances to join their network, unlike previous online social networking communities, which link people with similar interests. MySpace is another social networking service that was launched by a group of musicians for people to share their work in music. However it shortly served that the social networking service cause as becoming a major venue for sharing videos and photos.

Another growing trend is peer-to-peer networking, namely P2P. P2P configuration refers to network of peers using proper information and communications systems, in which two or more individuals are able to communicate spontaneously without any central coordination. Consequently P2P network depends heavily upon computing power at the end of each connection instead of the network itself [5].

Mobile Networking Services

Mobile social networking is a form of social networking where individuals of similar interests or communicates converse and connect with one another using the mobile phone. The nature of mobile phone allow it to be used for social networking service as people routinely carry a mobile phone with it and use it for communications. Here it presents a number of mobile social networking applications. MamJam is a location-based instant messaging platform for mobile phones based in the UK. It uses a system to identify user's location in real time with GSM mobile handsets. Like Mamjam, Rummble is the locative service for mobile phone, which connects people who have similar concerns or topics of conversation. Rummble members can communicate within their postal code. Dodgeball, based on locative service, enables to meet up friends within urban areas where is available in 22 cities in the US. Although Dodgeball is currently free to use users are charged by their mobile carriers for each text message they send and receive through Dodgeball. Dodgeball does not use tracking signals like GPS to determine where its members are. However users must actively inform Dodgeball where they are by sending a text message to Dodgeball with their location [6]. Plazes is a location-aware interaction system that helps mobile users hook up with friends or other like-minded people anywhere on the globe [7]. In order to match with people within walking distance who have similar interests and want to meet face-to-face Jambo uses Wi-Fi laptops, cellular phones and PDAs. Similarly ProxiDating allows users to meet strangers with common interests in close proximity. It alerts user's mobile phone if matching people are within 15 meters.

Reflecting on above case studies most of popular social networking services are relevant to meeting friends within a radius of permission and reciprocating messages by mobile phones.

RELEVANT RESEARCH

Good Abandonment in Mobile and PC Internet Search

The concept of good abandonment is defined as an abandoned query for which the user's information need was successfully addressed by the search results pages, with no need to click on a result or refine the query. The researchers randomly sampled abandoned queries from Google's PC and mobile search logs from a week in September to October, 2008. They sampled 400 abandoned mobile and 400 abandoned PC queries from Japan (Japanese) and US (English), and 1000 abandoned mobile and 1000 abandoned PC queries from China (Simplified Chinese).

Here researchers classified a query as a potential good abandonment if there is a dominant information need associated with the query that could theoretically be achieved by Internet search engine results page. In terms of likely good abandonment rate it is how often the search engine is providing results that likely results in good abandonment for users, as a subset of the queries that potentially could lead to good abandonment. It is classified as 'Yes' if researchers felt a query's information need was clearly met on the results, 'Maybe' if they were less sure or there was partial information, and 'No' otherwise.

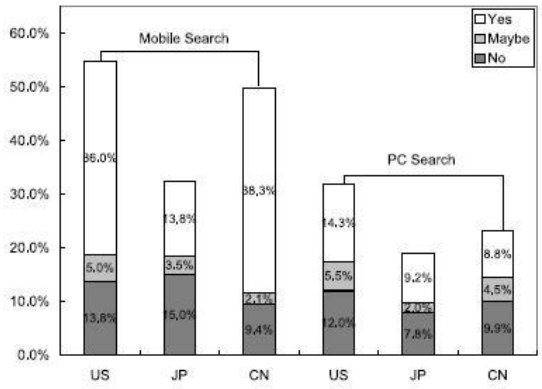

Fig. 2 Percentage of potential good abandonment queries which are classified as Yes/Maybe/No with respect to the likely good abandonment definition (LiJane, HuffmanScott, TokudaAkihito, 2009)

So as to measure the likely good abandonment rate it

examined the actual results page returned by Google, with the purpose of determining whether query's information need is currently met on the search results page.

Fig. 2 shows the search engine is successfully 'answering' a greater proportion of the mobile queries that are potentially answerable on the results page. For PC search an average of 56 percent of potential good abandonments were clearly or possibly met on the results page. For mobile search it illustrates 70 percent. In other words the rate of potential good abandonment is significantly higher for mobile query streams than the PC query streams [8].

Intelligent Mobile Search

Existing search engines suffer from significant coverage and relevance issues with many queries either going unanswered or being answered by misleading result-lists containing irrelevant results.

In addition to these coverage and relevance issues presentation and interface design becomes much more critical in mobile search than in traditional Internet search. For more economic use of limited screen real-estate the alternative approach are studying to search result that satisfies the informativeness of snippet text. The core idea behind this approach is to replace result snippets with a much shorter text representation that is made up of the terms of related queries that have led to the selection of particular result in the past [9]. This trial has been made possible as a direct consequence of community-based personalised meta-search engine called 'I-SPY', which records the queries and search results of different communities of users. Further it provides users with search results that are informed by past search behavior of a community of like-mined users. Specially I-SPY monitors users selections or hits and maintains a record of queries, and result selections [10].

I-SPY maintains a separate profile for different communities of users. For instance searches which originate on a monitoring web site are kept separate from searches that originate from a wildlife web site. This separation of communities allows I-SPY to predict that users of the monitoring web site are more likely to be looking for sports car sites when they enter the query 'jaguar', whilst users of the wildlife site are most likely to be looking for information on large cats for the same query. According to the recent study it shows how I-SPY, working with Google as its underlying search engine, can reduce the percentage of search failure and improve the positioning of relevant results when compared to Google [11].

Mobile Search with Text Messages

The user transmits a query in a text message to the Google SMS short code. Google receives the user's message, parses the query, attempts to retrieve relevant information and sends results back in one or a number of SMS messages. This service aims at supporting searches for specialised information such as business listings, residential listings, product prices, dictionary definitions, zip codes, etc. Despite its convenience it has a number of constraints such as several pages over 160 characters per message, LIFO (Last In First Out) problem of message order, and input technology problem for misspelled query [12].

CONCEPTUAL MODELS

Requirements

Most of mobiles, if not all, should support location-based service. Unless the mobile phone can be recognised its location, he/she has to inform his/her geographical position to information dedicator.

Social networking service on mobile should build up well and organise semi-expert or expert group in various interests. In order to join as a member of social networking search group he/she should go through the form of his/her interests and testify expert knowledge.

Information Provider

As a mediator between sendee and sender it needs to decide who plays a role of 'information provider'. Information provider can be considered as a new player in mobile value chain. The existing network providers may undertake mediated role, but appearance of new player may be expected on the stage. Figure 3 illustrates how the request from user transmits to mobile social network and returns back the response. When user requests the query it transmits either the network provider or information provider. The network provider can become an information provider or not. If the network provider is same as information provider it can be provided mobile social searching service to subscribers pro bono. Unless, the information provider acts as a new business player to both the user and the network provider. It implies new business opportunity for mobile value chain, which is due to scrutinise in the future work.

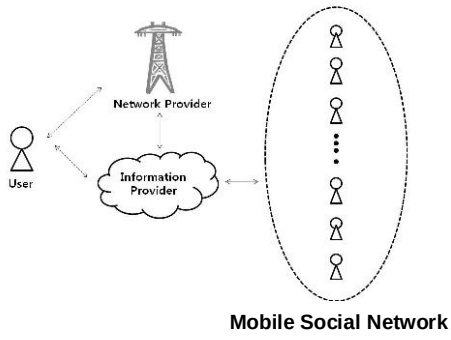

Fig. 3 Information provider as a new player

Public Dedication and Reward Regime

Wikipedia as collective intelligence has been accomplished public dedication for sharing knowledge system without any monetary reward. Users are benefiting by their unrewarded dedication. If someone, who is a semi-expert in specific field as blogger, receives the requested SMS from who needs to obtain useful information, it should proffer some reward to information dedicator.

It can consider as adequate rewards such as the cut-off of mobile cost, free-to-use-SMS, virtual money, mileage save, etc. The pivotal point of mobile social networking search would be how many users congregate into social networking group. In order to induce the active participation the adequate reward regime needs to social network users.

Creditability and Filtering System

According to the report[13] middle and high school students in S. Korea indicates 71 SMS daily use in 2004. Further nine of ten mobile subscribers have used mobile Internet and added services and the most frequent use has been reported SMS. If mobile SNS is well-constructed, someone may receive hundreds of hundreds SMS from information dedicators as well as spam, advertising and unwelcoming SMS. So as to filter unwilling SMS it needs to select and throw received texts. The filtering system depends on the creditability of user in SNS, which can be estimated by receiver with previous dedication whether given information were accurate or not. For more efficient interoperation the estimation should be the user's duty rather than optional procedure.

Acceptable and Unacceptable SMS

In hectic minutes it has rather turn off the function of social networking search than spill over an amount of text messages. It can provide the functionality of SMS-on and SMS–off which permit text messages for request or reject them. This functionality should be considered as optional menu at the stage of mobile manufacturing. Thus the alternative user may power off his/her mobile simply during business hour.

CONCLUSION

As mentioned above social networking search has a great possibility to present more enhanced searching service beyond mobile web search. However it has a number of constraints: privacy infringement, overcrowding, inaccurate information, filtering over unnecessary advertisements, etc. Moreover there are a misspelling and misunderstanding problems due to condensed sentences.

Since 1995 in the US 'classmate.com' has started up as the first social network service in the world, which the people sought their persons known such as alumni even comrade in arms. Indeed social network service is a sort of community web site to share information and construct human network through the Internet. The formal example of social network service is the Facebook or Twitter. The word 'Twitter' has been enthroned as the most influential word in 2009. This megatrend shifts Internet into mobile device.

However, so far, social network service in mobile was mostly relevant to find friends and organizes enthusiastic communities. In this paper it suggests mobile social networking search beyond simple mobile fandom, which is to obtain useful information through SMS rather than Internet mobile service. A number of factors should be considered: price, response time, good abandonment and satisfaction. At the future study it will present the experimental results using by the above factors and usability test which is to examine the degree of MSNS effectiveness between mobile social networking group and mobile Internet group. Furthermore the new value chain network would be implemented by information provider as a new player and whether it is a viable business in mobile marketplace or not, as well as scenario as more crystal concept.

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The Embodied Hybrid Space: Designing for Digital Encounters in Physical Environments

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ABSTRACT
The emergence of mobile and ubiquitous computing has created what is referred to as a hybrid space – a virtual layer of digital information and interaction opportunities that sits on top and augments the physical environment. The increasing connectedness through such media, from anywhere to anybody at anytime, makes us less dependent on being physically present somewhere in particular. But, what is the role of ubiquitous computing in making physical presence at a particular place more attractive? Acknowledging historic context and identity as important attributes of place, this work embarks on a 'global sense of place' in which the cultural diversity, multiple identities, backgrounds, skills and experiences of people traversing a place are regarded as social assets of that place.

The aim is to explore ways how physical architecture and infrastructure of a place can be mediated towards making invisible social assets visible, thus augmenting people's situated social experience. Thereby, the focus is on embodied media, i.e. media that materialise digital information as observable and sometimes interactive parts of the physical environment hence amplify people's real world experience, rather than substituting or moving it to virtual spaces.

Keywords
Embodied Media, Amplified Reality, Ambient Displays, Public Displays, Urban Informatics

AIMS AND BACKGROUND
Our spatial practices and situated experiences are shaped by the physical environment as well as the socio-cultural context of a place. Alexander et al. (1977) propose patterns guiding the design of physical infrastructure towards supporting particular social activities, such as a city plaza for a relaxing walk or serendipitous social encounters. John Ruskin (1849) speaks of the 'eloquence of architecture.' He suggests that there are more abstract things that we want from buildings beyond just providing a shelter in a physical sense; we want buildings to speak to us. Office spaces should afford efficient working environments, our homes should facilitate relaxation and a sense of domesticity, and churches provide a deep sense of spirituality. Architecture, from this point of view, can be regarded as an object of design with a goal to communicate a message or to provide "an impression of the psychological and moral attitudes it supports" (De Botton, 2006, p. 76).

Social and cultural theorists on the other hand remind us that 'place' is not only about its location, spatial infrastructure and physical characteristics, but more so socially produced (Certeau & Rendall, 1984; Gordon & de Souza e Silva, 2011; Lefebvre, 1991; Tuan, 1977), e.g. through practices, activities, memories and meanings that people attach to a place. Such 'soft' aspects contribute a perceived social atmosphere and culture that we consider as significant components of what we think of when we say 'I like this place' – they shape our 'sense of place.' In conclusion, people's sense of place as well as their practices and experiences within a place are influenced by both, physical environment as well as the socio-cultural context of a place.

The point of departure of this study is the impact that globalisation and the introduction of information and communication technologies (ICT) have on people's sense of place, i.e. their relationship to place and to other people within the same place. Globalisation and urbanisation have been criticised in that they shape more and more of our space on earth as 'non-places,' i.e. places that miss a specific local character (Auge, 1995). Shopping malls, freeways, convenience stores and fast-food chains look and feel the same everywhere. Places become 'inauthentic' and 'placeless' (Relph, 1976). Literature in urban studies suggests that there is a need to support cities' identities and cultural heritage in order to counteract such negative effects of globalisation and supermodernities (Auge, 1995; Harvey, 1996), thus preserving the traditional 'sense of place' of and within cities. In order for a city to be a 'good place' it needs to embody and reflect its historic context,

identity and unique traditions as well as provide a public place for sociality (Jacobs, 1961; Whyte, 1980), otherwise a place turns into a non-place.

The introduction of ICT has brought both challenges and opportunities for physical place. With the increasing pervasiveness of ICT, in particular mobile phones, people can bridge physical barriers and access distant information as well as connect to anybody, at anytime, from anywhere. As a consequence however, being physically present at a particular place becomes less significant. "Because connections are to people and not to places, the technology affords shifting of work and community ties from linking people-in-places to people wherever they are" (Wellman, 2002, p. 15). People-to-people relationships depend less on particular places, hence social closeness does not infer physical closeness any longer – we have become 'networked individuals' (Wellman, 2002). Some argue that connecting to distant others causes an 'absent presence' (Gergen, 2002) and isolation of people from their immediate social environment (Uzzell, 2008), i.e. being connected everywhere to anybody at anytime, comes at the cost of people's sense and appreciation of the here, nearby and now. Putnam for example argues a decrease of local community networks and the social capital within urban spaces partially due to the impacts of ICT (Putnam, 1995).

Public libraries represent a concrete example of a physical place that has been highly affected by the emergence and integration of ICT. The option to borrow and access e-books from home, as well as the increased availability of other online information sources, challenges the relevance and purpose of library buildings as a physical place. If all human knowledge is perpetually being archived and made accessible through the Internet, sometimes even in real-time, why would people go to the library any longer? Are libraries losing their advantage of being a physical destination? What can and should libraries provide in the future? What is the benefit and strength behind having physical library buildings beyond being able to store rows of shelves filled with books? How can libraries leverage their physical manifestation as an asset towards providing services that are complementary to and not replaceable by the online world? In their mission as a facilitator for education and learning, libraries have been challenged to think about their future role alongside what the digital world offers towards meeting the changing needs of members of the public.

This work tackles the issue of the 'lost advantage of physical space' in the context of libraries. It investigates how physical presence in a library can be made more attractive through the means of ubiquitous computing technology, in particular embodied media that are designed as a part of physical infrastructure. Hence, the building, interior architecture and space in and around a library itself is investigated towards becoming an embodied medium and place for digital social interaction, fostering the visitor's experience within the library's physical manifestation, rather than substituting or moving it to virtual spaces. The resulting medium, a combination of physical and digital components, is what the title of this paper refers to as an "embodied hybrid space."

The design interventions applied in this work recognise that physical spaces incorporate some characteristics that cannot be compensated by virtual spaces. Libraries in particular, despite being physical hubs and archives for information and knowledge, also serve specific higher level roles. Freeman describes those as "to advance and enrich the student's educational experience" and underlines that "…by cutting across all disciplines and functions, the library also serves a significant social role. It is a place where people come together on levels and in ways that they might not in the residence hall, classroom, or off-campus location. Upon entering the library, the student becomes part of a larger community – a community that endows one with a greater sense of self and higher purpose. Students inform us that they want their library to 'feel bigger than they are.' They want to be part of the richness of the tradition of scholarship as well as its expectation of the future. They want to experience a sense of inspiration." (Freeman, 2005, p. 6). With the physical building as a manifestation of these aspirations, the library provides a particular "sense of place" – an experience of various people coming together to a centralised location for similar, mostly educational purposes.

The focal point of this research is to investigate how people's perceived 'sense' of a place can be amplified through digital means. Informed through embodied interaction research, we in particular explore opportunities through embodied media, i.e. media that materialise digital information as observable and sometimes interactive parts of the physical environment. They enable people to bridge spatial, temporal and social barriers and make meaningful experiences in and through physical places, which would not be possible otherwise. Similar to augmented reality, embodied media enrich the real through the digital, but do this in a way that is publicly accessible through direct observation, manipulation or interaction with objects in physical environment, e.g. public touch-screen or ambient information displays. Using the concept of embodiment (Dourish, 2001), digital information and interaction affordances become a public and visible commonality of space. The motivation is to investigate the implications of embodied media for people's shared sense of and social experience in a particular place.

RESEARCH QUESTIONS AND APPROACH

In order to explore opportunities provided by ubiquitous computing technology and embodied interaction, and investigate their impact on sense of place, we focus on an explicit case study environment – the Edge. The Edge (http://edgeqld.org.au/), an initiative of the State Library of Queensland (SLQ) in Brisbane, Australia, represents a tangible example and prototype of a new library concept as part of SLQ's evolution in the digital information age. As

an answer to the lost advantages of physical space in traditional libraries, for example through online information repositories and search engines, its concept focuses on the social space and human factors of its visitors. Officially labelled as a '*Digital Culture Centre'* it maintains the library's traditional values as a physical hub for knowledge and information, though, not through books and information archives but as a "*hub for both planned and incidental collaboration – people stumble upon each other and create new possibilities that wouldn't have existed otherwise*" (unconventionbrisbane.com, 2010). Providing a master-planned place and cutting edge technical infrastructure, it envisions to attract, support and nourish a community of primarily young people to meet, explore, experience, learn and teach each other creative practices in various areas related to digital technology and arts.

The Edge was launched in February 2010 as the first institution of its kind in Australia. Our preliminary findings indicate that the Edge, having introduced this innovative concept of a Digital Culture Centre, still provides a weak identity of place. The general public, in particular first time visitors have a weak sense of what the Edge is and what it provides. Even though a lot of resources have been invested in its physical architecture, interior design and infrastructure, it remains a challenge for the Edge to shape its socio-cultural space and visitor activities as envisioned by its architects, i.e. facilitate shared and serendipitous encounters among visitors, collaborations, discussions, sharing of ideas and other forms of open-minded peer-interactions. Based on these preliminary findings, the key question guiding this research is:

What are the strategies to employ ubiquitous computing technology, in particular embodied media to facilitate a stronger shared sense of and social experience at the Edge as perceived by its visitors?

In order to gather an understanding of the social space at the Edge as well as evaluate how future design interventions affect this space, we apply Lefebvre's triad of social space (1991) as a conceptual framework. It provides a trialectic lens (Soja, 1996) for spatial thinking, i.e. from a (1) conceived, (3) perceived and (3) lived point of view. Thereby we regard the *conceived space* of the Edge as the vision and long-term goals set by the Queensland Government and SLQ as the funders and initiators of the Edge. The *perceived space* represents the infrastructure, services and facilities that the Edge as an institution provides towards fulfilling its purpose and mission, and how these are perceived by its visitors. The *lived space* represents how individual Edge visitors live and practice the Edge as a social space on an everyday basis, and the underlying motivations for their spatial practices.

The following sub-questions will guide the research process towards potential solutions for the specific case study environment at the Edge.

RQ 1) What is the conceived identity and 'sense of place' as envisioned by the Edge's makers and designers? What is the Edge's targeted role, vision and mission?

RQ 2) How is the Edge's identity and 'sense of place' perceived by visitors and staff members, and how is that reflected in their lived activities, practices and behavioural patterns in their everyday visits and work life?

RQ 3) ***How can ubiquitous computing technology be designed towards supporting a stronger sense and identity of place for visitors at the Edge (perceived space)? How can it facilitate activities (lived space) that meet the intended purpose of designed space at the Edge (conceived space) – especially in regards to visitor engagement, participation and incidental collaboration?***

The research questions, as stated above, focus on three aspects: (1) The Edge as place yet-to-be shaped and communicated in regards to its identity; guided by RQ1, we first investigate the Edge as an envisioned prototype for a new library and its role in providing a response to people's needs in the digital information age. We analyse the Edge from a conceived point of view, i.e. why it was built and which purposes it strives to achieve. RQ2 sheds light on how the Edge as a social space is perceived, used and lived through its visitors' and staff members' everyday activities. Based on the findings of RQ1 and RQ2, RQ3 aims to explore opportunities provided by embodied media to augment the Edge as a perceived and lived space. Thereby, we plan to engage in design, development and evaluation of a set of selected new embodied media prototypes informed by the organisational and socio-cultural context of the Edge.

The case study at the Edge analyses how different ambient media and content can enhance the identity and sense of a place as perceived by its visitors. The nature of these goals implicitly suggests a conceptual framework that holds characteristics of both, Action Research (targeted at social change) and Design Science Research (targeted at the creation of innovative design artefacts). Hence, the study utilises a design-oriented Action Research approach, i.e. a framework, which in principal follows the canonical goals of Action Research, yet has an orientation towards designing and building new technology artefacts as intended by Design Science Research.

DESIGN INTERVENTION IDEA

This section outlines a first draft for a potential design intervention at the Edge. We expect this plan to be further shaped or even changed through the iterative process of action planning, action taking and evaluation. The proposed design intervention is an ambient information system that aims to facilitate shared encounters and a better sense of other visitors who are currently at the Edge.

The system enables visitors to virtually 'check-in' at the Edge (e.g. using their Edge ID swipe-card or a mobile

phone application). Keeping track of 'checked-in' visitors and the digital footprints they leave at the Edge, the system will display a visual patchwork of aggregated information, e.g. who are the people who currently hang out at the Edge? What are their backgrounds, interests and key areas of expertise? What projects are they working on and what questions are they currently struggling with? The items are presented in a tag-cloud, while the size of keywords is determined by the number of people and level of expertise these people have in the given field. New visitors who enter the Edge get a glimpse of what profiles and knowledge other visitors who are or who have recently been at the Edge inhabit (Figure 1).

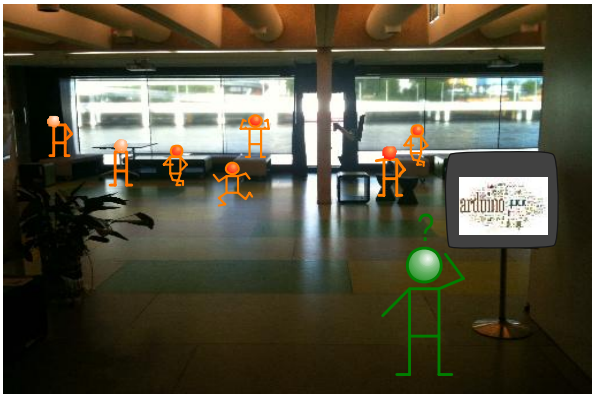

Figure 1: Ambient and public displays mediate a sense of place at the Edge and facilitate shared encounters between visitors.

The public screens with people's areas of knowledge and expertise is expected to strengthen visitors' 'sense of place' at the Edge, as well as the identity of the Edge as a place defined through the diversity of its visitors and opportunities evolving from this diversity. This gives visitors a sense of what the place is about. The focus is set on the visitor base, promoting the Edge as a hub of creative people and their knowledge and expertise in topics relevant to any form of digital culture. Rather than highlighting the infrastructure and technical equipment, it promotes the Edge as a space that is socially produced by and through visitors. The screens dynamically display the available assets and social capital at the Edge at each point in time.

Furthermore, the displays aim to help visitors make serendipitous in-situ encounters, i.e. identify and ice-break conversations and potential collaboration opportunities with fellow visitors who have similar or complementary interests, skills or knowledge. Visitors who check-in at the Edge can specify if they are happy to be approached or if they prefer to work alone. Ambient lights installed in the window bays will glow green or red, depending on what option the visitor has selected when he checked-in.

In contrast to most previous work about digital projections on physical buildings (Scheible & Ojala, 2009), the focus of this study is not simply on digitally augmenting the building in an artistic way, but rather on bringing it alive towards conveying relevant information about its current status, events, people, social encounters and the like which is happening inside the building. The design of the installation would follow the paradigms of public and ambient displays (Greenberg & Rounding, 2001; Guzman, Yau, Gagliano, Park, & Dey, 2004; Hazlewood, Connelly, Makice, & Lim, 2008; Mankoff et al., 2003; Rogers, Hazlewood, Marshall, Dalton, & Hertrich, 2010; Wisneski et al., 1998), conveying information in an unobtrusive, non-distracting, yet visually appealing way.

Combining in-situ advantages of the physical space with the benefits and 'social translucence' of digital ICT and social media, the overall aim is to explore how ambient and public displays can facilitate and augment social interaction in the hybrid space. The system is expected to contribute to the overall visitor experience and motivation to visit the Edge. The advantage of being physically present at the Edge is increased by the sense of community, exposure to a variety of topics embodied in the community, and afforded links to particular individuals within this community.

INNOVATION

The findings from the case will produce actionable knowledge for the Edge. Even though the case study tackles issues in the particular context of the Edge, the findings might be applicable to other institutions of the GLAM (galleries, libraries, archives, museums) sector with similar settings and goals as well as inform the role of embodied media for placemaking strategies in general. Furthermore, the results will inform and contribute new knowledge to the research community of urban informatics and human-computer interaction, in particular relevant to interaction design matters of mobile, embodied and ambient information systems.

Combining design and development of innovative prototype artefacts that mediate people-to-place relationships and methodologies from human geography, this work is timely and significant to both place-based technology and human geography oriented studies. As Humphreys notes, *"despite a 25-year history of computer-mediated communication research, the role of physical and social spatial practice has been relatively neglected in the field"* (Humphreys, 2010, p. 775). This work follows a recent trend of studies that have recognised the significance and importance of studying the interplay between people's spatial practice and the embodiment and ubiquitous integration of computing devices in our everyday environments (Dourish, 2006; Dourish & Bell, 2007; Galloway & Matthew, 2006; Gordon & de Souza e Silva, 2011; Willis, 2010). The study's findings contribute to this body of research by informing a design and development process of innovative embodied artefacts and evaluating their impact on socio-cultural settings and spatial practices in the specific context of future library models.

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CRUCIALLY IMPORTANT DISPOSITION OF FLUORESCENT PINK ROSE PETALS IN SPACE

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ABSTRACT
Computer technology and ambient media are playing an important role in contemporary art. They enable artist to implement a new approach in integration of audience into an art work, and vice versa. The content of the artwork is enriched with completely different meaning. The spectator becomes not only the legitimate part of an artwork; he is also its co-creator.

When I create ambience or artistic installations, I am never doing it with any kind of predomination. I don't think beforehand. It is not my intention to solve any problem, to point to a problem or its solution, or to comment or judge anything. Everything is perfect just the way it is, anyway. My only motif and intention is to absolutely enjoy, and to share this feeling and emotion of joy and fun. I simply follow my instinct, my intuition and my bliss. Ideas come spontaneously, with absolute joy.

I feel that good artwork consists of two parts. One is small, the one that is observed by senses, or eyes, ears, touch. This is an initial impulse for the consumer; it is not wise if this part is descriptive, too obvious, because it would distract another, bigger part of an artwork. This part is happening in spectators mind and heart, this is an invisible part.

Keywords
Art, artistic, installations, motif, co-creation, content

INTRODUCTION
There is an excellent example of integrating a spectator in an artwork in Rembrandt's painting "Night Watch". Instead of painting portraits of a people who are just posing for a painter, he created the theatrical scene, costumes, plot on a stage, lightning effects. The spectator couldn't resist being involved and integrated in a picture with his mind and emotions, but still without really becoming a physical part of an artwork.

I am also trying to offer a different approach and make a synthesis of all the elements of an artwork, and to integrate a spectator in an artwork physically as well, enabling a creation process to flow in the following directions: author-artwork, spectator-artwork, author-spectator-artwork. I use ambient media approach for this process.

I am producing ambience or artistic installations for more then ten years.

- In "Nasturtium", (artistic installation, 1999, Contemporary Art Gallery, Nish, Serbia), the spectator could move trough the abstract forest which was composed of digital prints of a leaves wrapped around the pillars of the gallery, small mirrors waving from the ceiling, and empty gallery walls. Outside the walls there was a real forest in the park. The subtle reflex of the spectators in the mirrors made them being a part of an artwork.

  http://www.aleksandravasovic.com/nasturtium.htm

- In the second part of "Only the ball" (artistic installation, 2001,Center for Cultural decontamination, Belgrade, Serbia), spectators were able to move and play with the parts of an installation which consisted of computer animation and balls for basketball and lightning effects.

  http://www.aleksandravasovic.com/onlytheball.htm

- In "Diamond" (artistic installation, 2007, ULUS Gallery, Belgrade, Serbia), spectators were directed to move in the certain manner. The artwork consisted of computer animation of a huge rotating diamond, digital prints with sequences from the animation, and lightning effects.

  http://www.aleksandravasovic.com/diamond.htm

- In “Golden Room” (artistic installation, 2009, Qucera Gallery, Belgrade, Serbia), which consisted of computer animation and lightning effects, spectators were able to take an impression that they are in a golden room, which had no doors nor windows, and to see the reflection of the total situation in the ceiling mirror of monumental size.

  http://www.aleksandravasovic.com/goldenroom.htm

DESCRIPTION

“Crucially important disposition of fluorescent pink rose petals in space” is artistic installation which enables the spectators to be a surface for presenting the computer animation. Art installation consists of computer animation of fluorescent pink rose petals flying trough space with some lightning effects incorporated in animation itself. Lightning effects are fluorescent pink light which sparkles from time to time. Animation is presented on the walls and on the several semi-transparent vertical backgrounds that are hanging from the ceiling to the floor. Animation is also presented on the bodies and faces of the people walking trough space between the semi-transparent surfaces. When somebody is exposed to animation and its lightning effects by walking trough the space, it seems that the observer is a part of the installation and the installation is a part of the observer. There is an interaction between all elements of the installation, including the observers. The disposition of fluorescent pink rose petals in space changes every second and makes different scene and impression. Every scene is different, the scenes are never the same, they are in constant state of change. Also, everybody has his own interpretation of the scene and impression. So, everybody has infinite number of completely different scenes and impressions. For the visitors, each of them has crucially important disposition of fluorescent pink rose petals in space, because it will be gone and change completely in the very next moment, and will never be the same.

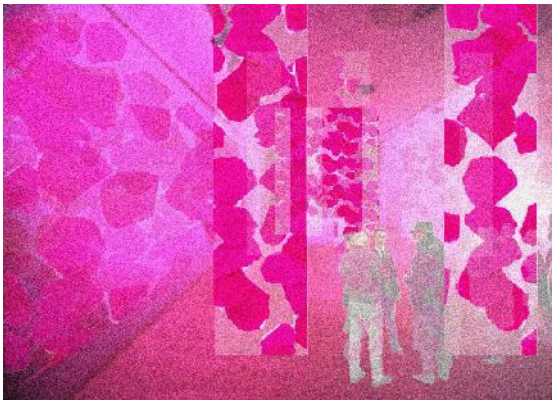
The computer animation is presented by one or several computers or DVD players and a video bim projectors.

This artwork also exists in a form of paintings, drawings, digital prints and on the web. The digital print version has been exhibited at VIII Salon de arte digital. 2009, Museo de Arte Contemporáneo del ZULIA, MACZUL, Venezuela, and got the special recommendation of the jury.

The art installation has not been exhibited in a gallery yet, but it is not impossible that it could be exhibited in June 2011.

http://www.aleksandravasovic.com/rosepetals.html

http://www.youtube.com/user/artasv#p/u



Metadata For the Masses: Implications of the Pervasive, Easy Availability of Metadata in Text, Video, Photography and Objects

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Abstract
Metadata "is a set of data that describes and gives information about other data". The widespread availability of metadata is permeating nearly every facet of our lives. It is creating a new paradigm moving from device and file specific locations to access by "the cloud", using remote computer networks for storage and processing. Other metadata is being created from devices interpreting the real world and also from sensors embedded in various physical objects giving real time feedback. This paper focus on how metadata has impacted text, video, photography and objects allowing for faster and better communication, analysis and knowledge of the world.

Keywords
Metadata, ambient media, hypertext, text, photography, GPS

Metadata "is a set of data that describes and gives information about other data"[1]. Early non-digital metadata was used in library card catalogs, giving information such as name, location, and a summary of a books contents. The metadata would make it easy to decide if we wanted to look at this book or another. A similar application of metadata is used by digital audio, video and text files. Audio file metadata might contain the name of the artist, album, or length of a song. There has been a rapid growth of the availability and complexity of metadata provided from various information services.

Beyond simple growth in availability the nature of metadata is evolving in usage, location and type. Large amounts of metadata are used by computers without our direct knowledge in order to launch a correct program or structure web pages based on underlying metadata specifications. Location and structure of metadata have transformed from localized to a non-localized format. Previously all data files were placed on a hard drive inside the computer we were using. Metadata is changing into information that can be accessed from anywhere and longer exists in one specific location. New types of metadata are starting to permeate every aspect of our daily lives. We have sensor networks in our mobile devices, cars, GPS, etc. Being able to get nearly instant access to a large amount of meta-information has added a "sixth sense" of clarity and orientation. Our aim is to offer views into the growth and changes in metadata availability focusing within the fields text, video, physical objects and photography and make basic predictions for future metadata permutation and usage.

TEXT AND METADATA

There has been significant growth in text metadata. Currently text metadata includes font, point size, bold, italic, justification, location of file, number of words, etc. However, there is a growing availability of metadata within text used for improving the speed and emotional tone of communication.

Communication with text has changed. Previously when using written communication an assertion would be made, then defined and justified with long paragraphs of supporting information. Hyperlinks[2] are now used to streamline communication by instantly linking the viewer to support information. The reader can opt to follow the link, or not.. Another example from online collaborative paper writing (like this one) allows comments that are linked to areas being worked on helping speed critique, and clarification.

Visually text is also changing. Beyond embedding literal data into the text, there is more iconic representation of words using acronyms and emotions as emoticons. Emoticons and acronyms are changing and embedding what used to be mere text into semiotic metadata. Instead

of saying "I'm happy", it is simpler to encode it into a symbol ":-)" or use "LOL" (for "laugh out loud"). There will undoubtedly be further augmentation of emotional or visual impact and meaning through additional rapid visual manipulation of text words. More efficiently changing font, size, bold, and italic for visual impact will encourage the growth of new visual systems in text. Beyond the visual, movement and audio are also being combined as metadata sources. New input technologies like the Microsoft pressure sensitive keyboard [3] could rapidly change the way we communicate with text by adding a layer of pressure metadata to text. Although this may initially be applied simply to text formatting or used in video games, there are other applications for adding movement to text as well. Currently there is a large amount of text animation done with motion graphics. But this could also be incorporated into text communication, adding a layer of kinesthetic metadata to text. The online service ToneCheck [5] analyzes text documents, mostly e-mails, to make sure the underlying emotional tone is e-mail friendly. Currently adding text by gesturing at a computer is considered humorous, but not too far away from becoming fact. Google's 2011 April Fools video [4] played with this idea, yet within 48 hours it was a prototyped reality created by ICTxR Lab [6].

The emerging trends in metadata within text based communication show an evolution in communication. Metadata-embedded text will more clearly and quickly express ideas, feelings. It is easy to imagine a further synthesis of multi-sensory feedback within future text communications. Greater visual changes in text font size, shape and color, as well as movement, touch, and sound will change how we communicate.

VIDEO AND METADATA; AUTOMATIC CREATION FROM ANALOG SOURCES

Beyond the blooming growth of metadata there are also many programs being used to interpret and create metadata from analog sources.

The video editing software Adobe Premiere [7] creates text metadata inside of video. It does this by scanning the audio track and performing a voice-to-text analysis. With this information a user can search a video for specific keywords, going directly to the desired part of the video.

Autodesk MatchMover software [8] analyzes video footage generating a 3D visualization of the environment. This allows for the creation of a virtual 3D camera, allowing for compositing of 3D objects into moving video footage. This type of hybrid analog/digital metadata information from computer vision is being combined with directional and global positioning systems [9](GPS) data and being used in products like Google Goggles [10], augmented reality [11], and the new geolocation picture sharing iPhone app Color [12].

The future of video and automatic metadata creation will see further increases in automatic identification and labeling. Facial recognition, object recognition, costs comparisons. Video analysis technology will be further integrated with motion capture technology like the Xbox Kinect, to give critiques on athletic form, to more refined critiques like body posture and poise for business presentations.

LOCATION AND METADATA

Metadata is changing its relationship from local hard drive storage on a single computer to storage accessible from any networked computer. Decentralized storage of data is changing the way we work. In the past few years data has begun moving to virtual locations which are accessible from any networked location. Google Docs, blogs, email and web pages are the most common form of decentralized information. Impacts from rapid shifts in technology have been seen in the entertainment industry. Analog media such as audiotape and videotape once stored music and video. Then the storage changed to objects holding digital information, such as CDs and DVDs. Next video and music became more mobile and less about being stored in a directly-accessible physical medium, changing to audio-data files, MP3, WAV, MOV etc. One step further and now files are no longer stored on a local machine. Video and music can stream from a list to a user's device. The bulk of information is stored non-locally. Netflix, Hulu and Amazon.com's new "Cloud Player"[13] work by looking at users' metadata list of their songs, artists, and music videos and then gets them streamed to their device on demand.

This is a major cultural change from a society which placed value in the physical to to a society that is more focused on being able to access data. This shift, "from atoms to bits"[14] is causing huge transformations in businesses formerly linked to making profit from the distribution of physical media such as CDs, newspapers, and DVDs. The newspaper, film and video game industries are all experiencing fundamental shifts in the way they do business. It is more convenient for most people to get a movie streamed to their TV than to go pick it up at a physical store.

DYNAMIC METADATA FROM PHYSICAL

OBJECTS

Text, music, and video files do not change when they are played multiple times or in different locations. Their data is static. Metadata gathered dynamically from physical objects is growing exponentially. Information that changes over time and is accessed on demand from and object physical objects will open the door to an enormous amount of new knowledge about ourselves and the way we live.

Cell phones are a common source of dynamic data. Triangulation and GPS information from cell phones can tell location information. Many cell phones can now also scan bar codes on objects in stores, such as food or books as well as augmented reality (AR) quick response (QR) codes. The bar code then links directly as in an AR code or or searches for the latest reviews, check calorie counts or even look to see if the item is on sale at another store. It is also possible to scan your airplane ticket to do an early check-in or see if your flight is on time. These are only part of a changeover from an analog world to a world laced with digital metadata. With the exception of the cell phone, the objects being scanned are for the most part non-dynamic, nor do these objects sense or emit metadata of their own. The greatest impact on culture from data and metadata will come from new types of objects that talk to us and each other, generating dynamic metadata.

Low cost sensors and remote frequency ID (RFID) tags are now embedded in many types of objects. These objects generate new, continuous and spontaneous streams of metadata . Pressure sensors for car tires detect inflation levels. Weight sensors in car seats can detect by the weight of the passenger who is driving and make seat adjustments. Sensors in bridges and other "smart" materials can confirm structural integrity. Our GPS-enabled cell phones can both tell us how to get somewhere, but also generate metadata about where were we and where we are going.

Future trends from objects that can instantly talk to other objects are many. Buying an object might be as simple as walking out of a store with it. Performing an inventory could be done in an instant. While initially the application and evaluation of new sources of dynamic metadata will undoubtedly be lined to commercial applications. GPS and RFID open up a culture for an hybridization of physical objects and being able to access them over the Internet. Object hyperlinking[15] and embedded real-time data opens up a whole new world of possibilities for an ontology of objects though various services like Pachube [16].

IMPLICATIONS OF THE PERVASIVE AVAILABILITY OF METADATA: AN EXAMPLE FROM PHOTOGRAPHY

Photography is both art and science. Skilled photographers know the limits of their equipment, and what kinds of camera settings will yield various kinds of results. Many of photography's parameters, like depth-of-field, are calculable. For others, such as the formula for avoiding camera shake, there are widely used rules-of-thumb. However, the ability to take a shot with engaging composition or compelling content remains part of the mystery-and mystique-of good photography.

Today's digital cameras capture information about nearly all of the measurable parameters in a photograph. This metadata includes information about focal length, aperture, shutter speed, film plane sensitivity, the lens and camera model used, distortion correction, image stabilization, white balance, metering pattern, and so on. When transferred to a computer, programs like Apple Aperture can sort photographs based on metadata about the entire digital corpus of a photographer. For example, Aperture [17] can find every photograph shot at a particular focal length, or every photograph shot with a flash.

While in the past, some photographers would consistently record this kind of information, others would not (or in the case of many street and sports photographers, could not) reliably capture every detail of how a shot was taken as part of the photographic process. Some information, such as film speed and camera model used, was often memorable or easily available. Other information, such as the precise focal length of a shot taken with a zoom lens, was nearly impossible to reliably capture in a rigorous way.

For contemporary photographers, the pervasive availability of many kinds of metadata has profound implications.

Being able to analyze a photographic corpus based on pervasively available metadata can add additional layers of quantification and understanding of the patterns in the corpus. It is now easy to quantify how many photographs were shot with a given aperture or shutter speed. This, combined with the ability to rate the quality of a given photograph (another of Aperture's features) enables the photographer to ask more sophisticated questions about her corpus and practices, such as: How many highly-rated photographs did I shoot with my 20mm lens wide open?

CONCLUSIONS

Old and new kinds of metadata are more widely available and easily accessible now than they have ever been. Having easy access to data about data has increased the culture's awareness of new uses for existing data. It has also created new possibilities for analyzing data that was previously tedious or impractical to use in a meaningful way. In photography, the pervasive and easy availability of many kinds of metadata means that photographers have new opportunities to catalog and analyze their body of work, and potentially to modify their practice. Metadata will no doubt change how other disciplines make use of their existing data in more and more sophisticated and self-aware ways.

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Virtual Rendering based Second Life Mobile Application to Control Ambient Media Services

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ABSTRACT
In this paper we propose the development details of a mobile client that allows virtual 3D avatar interaction and virtual 3D annotation control in Second Life. We established adaptation based virtual rendering of the Second Life client and encoded the real-time frames into video stream, which is suitable for mobile client rendering. Additionally, we re-mapped the touch-based interaction of the user and feed that to the Second Life client in a form of keyboard and mouse interactions. As a proof of concept, we annotated a virtual environment object in Second Life and linked that with a media service by UPnP [5]. Further, we captured the mobile interaction of the user and provided controller interface to change states of the media object through the virtual object interaction. We argue that by using the mobile Second Life virtual interface the user has a better look to monitor and control the home appliances. We present illustration of the prototype system and show its application in a smart environment setup.

Keywords
Virtual rendering, virtual home, Second Life, virtual world, virtual display, thin client

INTRODUCTION
Second Life is one of the most popular 3D virtual environments that acts as a medium of social interaction where people can build their virtual 3D home, customize and populate it with 3D furniture and other interactive devices. With the growing popularity of Second Life (SL) [13], users often design their virtual 3D homes mimicking that of their real smart homes. Smart homes are technologically augmented spaces where several interconnected devices; artifacts and other ambient services are available to support people. The lighting control service, ambient media service, and security service are few examples of services a smart home application may incorporate. With the decrease in the prices of electronic sensors and automation devices such as X10 [6], their usage to provide control and various entertainment facilities in smart spaces are becoming hugely popular. In order to efficiently control ambient media services inside a smart space, researchers have placed attention on the intuitive 3D GUI design and explored its usability issues [9] [17]. Compared to WIMP like 2D interfaces, a 3D user interface such as Second Life can improve interaction with smart home [14, 11].

Natural interaction with devices frees people from working in a desktop-like setting and provides intuitiveness in accessing various services of interest [12]. For example, when reading a newspaper, a person might want to turn on the media player while sitting on the couch using his/her mobile device. Users need support to get access to smart home anywhere and anytime. However, currently the mobile devices lack the graphics horsepower to render SL's 3D environment in a satisfactory way. SL uses gigabytes of textures, sounds and animation data that entail a huge amount of network download time and CPU processing time that can adversely affect frame rate, draw distance, render detail, and mostly the battery life. Therefore, in order to render SL in mobile device we adopt virtual display technique that incorporates device collaboration [19][16], where most computations are carried out remotely by leveraging remote computing resources, and screen updates are compressed and transmitted together with low-level display commands from servers to clients [18].

In the THINC [7] and the MobiDesk [8] architectures, virtual display buffer management and screen resizing were used for devices with different display resolutions. One of the closely related work was presented in ReDi [19] that proposed interactive virtual display system for ubiquitous devices using thin clients, through which users can efficiently leverage the local display capability and remote computing resources. However, unlike our approach additional portable kit was required to be attached with the display surface to provide a thin client with the said mobility option.

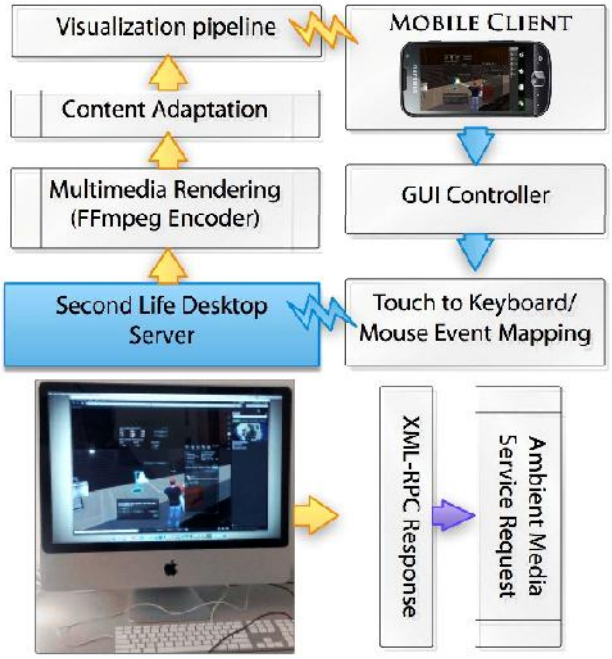

Figure 1. Virtual rendering based mobile Second Life client system architecture (intra-device communications are shown as arrow symbols).

In this paper we propose the design and development of a mobile 3D virtual interface of Second Life [9] [17] in order to access smart home media services. Our contribution in this paper is two-fold. First, in order to bridge the gap between virtual and real, we present a Second Life virtual environment annotation based smart space automation system, where we provide web-service based architecture for controlling our previously developed ambient services [15]. Second, we device a flexible system architecture for local and remote device communication by incorporating adaptive screen compression, interactive Region of Interest (ROI) control, and touch-based input processing. Our experiment shows that the proposed system can efficiently utilize the remote computing resources to render SL content and leverage that to access the ambient services.

The remainder of this paper is organized as the following. At first, in Section 2 we illustrate the proposed visual adaption scheme to render SL content in ubiquitous devices. Further in Section 3 we describe Second Life virtual annotation based ambient service interaction. At the end we provide conclusion of the paper in Section 4 and state some possible future work directions

Event based Adaptive Rendering

As depicted in Figure 1, in order to access SL content in mobile scree, we incorporated device collaboration scheme [18], where the Second Life virtual environment rendering took place at a remote desktop computer. Additionally we utilized the computing resources of that same to encode the Region of Interest (ROI) of the Second Life client window in H.263 format with RTP packetization support. The libavformat library of FFmpeg [2] options for video container muxing and transcoding of the multimedia files. The compressed and encoded screen updates were streamed to the mobile client by using real time streaming protocol (RTSP) [3]. The mobile client were able access the encoded content by listening to the incoming UDP [4] packets with the help of a custom streaming application that was developed from VideoView library [1].

Figure 2. Mobile client rendering remote stream in realtime.

The ROI window size of the desktop Second Life was kept at a constant *R={640x480}* sized rectangular block. The open source ffmpeg encoder scaled the screen updates into *320x240* H.263 video frames. In the desktop remote computer, RTSP was used to start the streaming. It provided us an SDP [10] profile that contained the description of the media type, format, and other associated properties. We designed our encoder system to manage an RTCP [1] connection and a RTP [2] encapsulation of the video channel. However, we did not implement the audio channel transcoder, as our focus was to interact and control smart home appliances only. While RTP carried the video stream, RTCP was used to monitor transmission statistics and the quality of service (QoS) parameters of the media stream. The RTP packets were streamed over UDP and we avoided the overhead of retransmitting lost packets.

The mobile client listened to the *client_port* of the RTSP stream and rendered the incoming media streams. RTSP had the overhead of requiring multiple requests before the playback can begin. However, the mobile client pipelined many of these requests and sent them over a single TCP connection. As discussed currently, the mobile client only supported video rendering without audio and performs only in landscape orientation (no accelerometer support). The video quality in thin-client based remote access is measured by the frame update rate as proposed by Yang et al [20].

[1] RTCP, http://wikipedia.org/wiki/RTP_Control_Protocol

[2] RTP, wikipedia.org/wiki/Real-time_Transport_Protocol

We were able to render SL content in the mobile client at *6-12* FPS with *320x240* resolution support. The remote rendering of SL screen ROI in the thin mobile client is shown in Figure 2.

References and Citations

On the top layer of the streaming mobile client application we added interaction-capturing interface. The interface listened to the touch interactions of the user and reported that to the desktop Second Life renderer through a buffered input pipeline. The pipeline implemented as a queue, processed the input list in Fast-In-First-Out (LIFO) fashion. However, the recent mobile clients that we adopted only accepted touch-based interactions. Hence, we proceeded with the interaction mapping and used the Table 1 as reference in the input processing.

When a user tapped on the touch screen we mapped that touch as a single mouse click and packaged that information along with the screen coordinate position where the tap took place. By associating delay in the tap we identified long tap and double taps, the mapping scheme converted these interactions into a right click and a double click respectively. In order to map the avatar navigation keys, we used our previously developed motion path analysis of the touch surface [15] and obtained four swiping symbols, namely *left*, *right*, *up*, and *down*. These four symbols were later mapped with the *left, right, up, down* arrow keys of the keyboard respectively. By using the said swipe touch gestures, we made it possible to navigate SL 3D home and interact with the 3D objects. Furthermore, we encapsulated the packet data with event messages that contains event trigger data (*1=Mouse, 2=Keyboard*), screen location data *S={x,y}*, and keyboard character or mouse click type data.

Table 1: Interaction mappings to traditional WIMP controls to conform touch gestures

ID	Touch Events	WIMP Mappings
1	Left swipe	Left key
2	Right swipe	Right key
3	Up swipe	Up key
4	Down swipe	Down key
5	Tap	Single click
6	Double tap	Double click
7	Long tap	Right click

AMBIENT INTERACTION SCHEME

In order to communicate with ambient media service we created 3D virtual objects in Second Life, representing the service access points for various ambient services such as a lamp or a media player. Further, we annotated a 3D lamp, media object in Second Life and added web-service calls to it in its mouse click event. We describe the object annotation scheme in section 3.1 and the web-service based remote communication approach in Section 3.2. Later in section 3.3 we illustrate the real lamp/media player control mechanism.

Object Annotation

In our system we annotated Second Life 3D objects and specified the corresponding ambient service addresses in it. We incorporated *lightON*, *lightOFF*, *playerON*, *playerOFF* animation for the 3D lamp and media objects in SL. These animations were defined in the annotation file and associated with the *ON* or *OFF* service states of the real world lamp and player. The animation sequence for the 3D lamp object contained an animation unique identifier (*UUID*) that worked as a pointer to the animation file (*BVH*), where animation speed, duration etc. were defined. This file also specified the physical device specific data like UPnP port forwarding address, name, type etc. The physical lamp device was connected with the ambient services by using X10 or Wi-Fi connections. Similarly, in second life a 3D lamp object was annotated using the Second Life's built-in script annotation mechanism[3].

Interaction with media player application occurred implicitly, where the media selector service automatically invoked context-aware services through the mobile interaction device. In Second Life, the 3D media player was annotated to customize the mouse click event. The mouse click event was overloaded with the remote web-service call that communicated with the ambient media selector running in the same workstation.

Remote Communications

The Second Life provides both commercial and open source versions of its client that is termed as viewer. The viewer brings a wide range of web-service and communication handling APIs that can be leveraged to create listeners for events inside Second Life. Web service APIs that are supported in Second Life are a) Raw HTTP access, where the requests are initiated through the events written in LSL scripts, b) XmlHTTP access paradigm, here requests are initiated by external services and c) Email option provides full two-way communication, but with enforced sleep timers.

This web-service based remote communication architecture provided the option to incorporate real-virtual interactions without affecting the functionality of the Second Life communication system. Inside Second Life we adopted the RAW Https access interface to perform machine-to-machine http communication. Each LSL scripted object had a maximum of *2048* characters limit for the http responses. The *llHTTPRequest* runs entirely on the simulator running the script, hence, the messages communication was not impaired because of the overloaded central Second Life servers. By using the mobile interface, the user navigated the 3D Second Life home with his/her avatars. When the 3D lamp/player object was interacted by the user, the developed LSL script module captured the messages relating to the real device in the mouse click event. By

[3] LSL Scripts, http://wiki.secondlife.com/wiki/LSL_Portal

using the *xmlHttp* access mechanism we created an UPnP response object for the ambient media selector (AMS). AMS further captured the response object and parsed that to obtain service port address *ID*. Lastly, by decoding the port addresses *ID* the AMS then sent control signal to either turn the media service state to be *ACTIVE* or *INACTIVE*. This process is called "port forwarding" and works seamlessly in this situation. With this process shown in Figure 4, we mapped a port forwarding programmatically without user interaction.

The SL script utility that contained annotated port mappings on an UPnP-enabled router allowed flexible control (add/edit/delete) of mappings. The utility was conceptually broken into two pieces: a media service that performed the actual work, and the mobile UI that invoked the service.

Interaction Controller

In the ambient framework, we enabled the access of various media services and facilitated the control of ambient lighting using a smart phone interface. User's media selection is played in VLC media player and ambient lighting is controlled using X10 home automation technology. To integrate mobile touch gesture with this framework, we first defined several gestures that can be mapped to specific operations required for accessing the available services. Recall, our proposed mobile gesture technique was based on touch motion path definition and hence it gave us the freedom to define customized gestures that are more natural in the given context and is easy for the user to remember.

```
http_request (key id, string method, string body)
  if (method == URL_REQUEST_GRANTED)
  { // Register our url for new status updates.
    llHTTPRequest("updater_url = "?URL=" + body + "/",[],"");
  }
  else if (method == "GET")
  { // Process a status update by parsing the query string
    string t = llGetHTTPHeader(id,"x-query-string");
    list l = llParseString2List(t,["/","=","&"],[]);
    integer i = llList2List(l,["Message"]) + 1;
    // Validate device status.
    if (i > 0)
    { llSetText(header + llUnescapeURL(llList2String(l,i)),<1,1,0>,1);
      llHTTPResponse(id,200,"OK");
      if (o == llList2Key(llGetParcelDetails(llDetectedPos(i),[PARCEL_DETAILS_OWNER]),0))
      AGENTS += llDetectedName(i);
      // Update object animation
      llStartAnimation(llList2String(this, animationObj));
    }
    else llHTTPResponse(id,400,"Must Specify a message!");
  }
}
```

Figure 3. Sample LSL code that loads the XML data to process messages towards the communication channel.

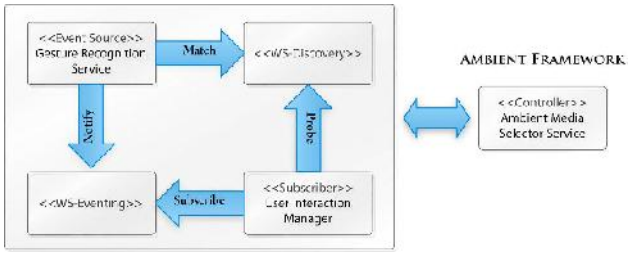

Figure 4. Integration of mobile-based service invocation UI and the ambient framework.

In a typical interaction scenario, the user navigated to the Second Life smart home by maneuvering the avatar with *left, right, up, down* touch based swipe gestures. The user could tap on a 3D lamp/player object to turn it *ON* inside the smart home and in turn the interaction-mapping algorithm would be generating a mouse click event. After receiving the remote interaction messages through scripts, the GUI events were generated in the remote Second Life client machine. Based on scaling method $nS = R = \{x,y\}$, where n is a constant, mobile screen to window ROI screen coordinates were calculated and mouse click event at the calculated R location was triggered. Afterwards, the event handler module of Second Life determined the particular event handling routine for the specified 3D lamp/player object. The handler then transferred UPnP response packet to the AMS in order to communicate with the actual home automation services.

CONCLUSION

In this paper we proposed a novel system to facilitate ubiquitous user interaction with ambient media services by using device adaption based mobile Second Life client system. The approach targeted to bridge the interaction gap between the virtual and real world media service selection mechanism in a mobile context. The developed system worked as a web-service and loosely coupled to the Second Life viewer. The animation and device control data were annotated in the 3D virtual object in Second Life. The 3D object representing a real device received inputs when interacted by a user and automatically responded with the state changes in the physical environment. The mobile client based pervasive access to the Second Life 3D environment is easy to use, and intuitive. The association of real lamp object to the virtual 3D object was natural and easy to understand. The proposed approach facilitated mobile use of digital devices by combining advanced display technologies, natural user input mechanisms, and remote high-performance computing resources with improved user accessibility.

In our future work we plan to evaluate users perception of the system in which we want to understand the ease of use, presented advantages, and intuitive factors of the prototype system. By using the motion path tool we plan to incorporate more gestures into the system.

We envision that these gestures would provide more control and support users with intuitive interactions capabilities. As in our system it is essentially easy to relate the real and the virtual 3D device representation we also want to explore the application in the elderly home control system.

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Experience to understand: designing a methodology for understanding kitchen interactions

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ABSTRACT
The following paper presents a methodology for user engagement into the interaction design process. It focuses on the group of middle-age, middle class mothers, housewives and individuals leading a busy life between work and family and their interaction with home, especially kitchen appliances. The methodology was developed to gain insight and achieve greater understanding of users in question. An ongoing study research with the described methodology is also presented.

Keywords
Interaction design, ethnography, user research, user experience design, kitchen heroes

INTRODUCTION

In the last decade, and especially in the last years, we are witnessing a significant design trend that is pushing producers of home appliances to come up with new, technologically advanced and even more importantly, (visual) design-centered products. Kitchen, as one of the vital places in every home is no exception. Companies are hiring renowned artists and industrial designers (eg. Ora Ito, Karim Rashid) looking for designs that would satisfy demands and expectations of its users (customers). The collaboration results in aesthetical products, pleasing to the eye and a true addition in a designer-savvy's kitchen. Technology wise, there is a significant trend of touch interfaces and trend of "smart" appliances. Smart usually means intelligence and autonomy through sensors, buttons and functions that (try to) interact with other devices and the user. Ovens suitable for total cooking beginners and refrigerators that monitor stored food and have integrated iPod dock and speakers are nowadays available on the market.

There is nothing wrong with nicer looking and more intelligent kitchen. However there is a fear that the user experience (UX) could be suffering and could be designed better. Kitchen appliances have the potential to be better connected into an intelligent ubiquitous system being part of a modern human-centered home. Yet it seems like designers and producers keep forgetting who their users are and what their expectations and goals are.

Our goal, is to bring focus back to the actual user, and to propose a methodology that leads towards better understanding of users. In our study, we focus mainly on interactions happening in the kitchen as we believe kitchen appliances are poorly designed because of misassumptions about priorities, the role of aesthetics and new features over usability.

Introducing kitchen heroes

In year 2007 a new label arose for trend-setting mothers, who lead a busy life, successfully leading a family and a career. A graphic designer and mom Constance Van Flandem labelled herself and her kin as the *alpha moms*. They are the tech-savvy, well educated perfectionists who utilize modern technology to tackle theirs busy schedules [1]. Alpha moms seem to be the target group for most companies developing anything connected with home appliances, including kitchen. However the user group who actually uses kitchen appliances the most are so called *kitchen heroes*. Kitchen heroes are average (mostly middle age) individuals leading a busy life between work and family. They represent the silent and almost never complaining majority of users using kitchen appliances on daily basis. This user group includes not only moms and housewives, but also home-staying parents and others. They may not be well educated, but are used to work, taking care of the family and all the domestic work.

The interaction designers' aim in this research is to address their needs and goals and include them in the interaction design process. Kitchen heroes in focus of the research study rarely complain about any piece of technology at home. Saffer (2007) talks about how humans have an amazing tendency to become accustomed to the inconvenient, even awkward. Kitchen heroes are used to make compromises, to adapt to technology as well as adapt

technology to their needs. For example, they use only a portion of functions embedded in a product. Most importantly they seek functionality over good user experience. No matter all the technological innovation and design trends, *kitchen heroes*' lives have not been made easier, or at least so appears. There are numerous reasons that should be identified and addressed with proper interaction design.

Mind your users

Interaction design as a process should commence immediately after the decision to introduce a new or redesign an existing product or service is made. Technological determinism [5], as called in theory could be avoided that way. The term describes technology as an independent force in societal development and a theory that describes users adopting to technology, which does not go well with interaction design principles which (should be) are user-oriented.

It seems though, that the previously defined user group of kitchen heroes is not recognized as significant. Especially when compared to other user groups, for example the elderly, people with disabilities or tech-savvy users that get more attention from the academia as well as the corporates. The intention of this study is to raise an awareness of the importance of knowing your user. A decade or so ago, adding more functions to a product represented added value. Nowadays company mindsets fortunately changed, and there is a trend of simplicity, which was and still is on the rise. While simplicity and emphasis on the core functionality is good, there are some approaches and technologies that could be overestimated. One example is the now almost ubiquitous touch functionality. Middle age, "average" [1] users in general are known not to be widely fond of touch interfaces, no matter how intuitive they ought to be. They are not digital natives and they needed years to adapt to certain technologies, which helped shaping their mental models [4]. Switching to touch and gestural interfaces for example, could prove as a painful experience.

Companies argue there are usability studies and research done to ensure they stay on the right track with development and innovation for a better user experience. While usability tests with users are essential, there are still some concerns. The first concern is connected with the selected user group. Namely there is a possibility to miss-define the user group. Even when the appropriate user group is used, it should be approached very thoughtful to gain honest feedback. As those humble people lead a life of constant compromises and work, they don't feel like the ones who should complain about bad usability. Second concern is connected to the core interaction design. Why only test high fidelity prototypes and finished products, when users could be involved in the design process from the beginning on.

THE RESEARH STUDY: EXPERIENCE TO UNDERSTAND

The research question in this research study is *how to connect existing devices and how to (re)design them into a ubiquitous system that could be utilized by the vast majority of people, with the focus on previously defined kitchen heroes?* People using kitchen appliances regularly participated in the user study. One of the greatest challenges was how to get them to open up towards the researcher and provide true and valuable feedback.

Methodology

Methodology for the previously stated research question was developed in the study. It is based on previous experience and knowledge gained while working with different user groups (usability studies and user-driven interaction design sessions) and on research done by other authors [9] [10].

Honest, critical input regarding user goals, intentions, wishes and expectations was needed. It was found out that any formal enquiries and usability tests don't work well with the typical users of this research. Observing and shadowing users was the first step for developing the actual research method.

The methodology aims to understand the user behaviour and mental models. It is based on ethnography [8], which derives from anthropology. Instead of asking the user group to point out frustrations and suggest improvements, suggested methodology seems fairly passive. The core method could be divided into three parts:

- Observation
- Participation
- Understanding

The first phase is based on observation of users in their homes and during their everyday activities. Cooking is, unlike watching television or surfing the Internet, significantly bound to cultural background. It is connected with various emotions, traditions, cultures, routines, etc. It is an activity that differs from nation to nation, even from family to family. Observation outside testing labs in users' natural environment is crucial when researchers and designers are to design for a good user experience.

Observation is followed by participation in activities together with users, such as shopping for grocery and cooking. Participation is also a step towards gaining trust of users involved, which is identified as an important element in our methodology. Active participation is a method often used in ethnography, especially when studying specific user groups connected through a certain interest. Cooking and domestic work might seem trivial, yet it needs more attention from designers and developers as well as researchers in order to design intelligent ubiquitous systems in service of its users.

Active participation and observation combined are key to understanding kitchen heroes. By tapping into everyday life of users and further on by participating with them,

interaction designer (also researcher) participates in a shared experience. With shared experience true understanding of user goals is possible. Understanding, the final part of proposed methodology, is achieved when designers or researchers involved in the process analyze all the information gathered while interacting with the selected group of users. Understanding guides designers, helps them design products that adapt to appropriate mental models and results in better user experience.

The developed methodology is a combination of different research methods and its dependence on ethnography also introduces same traps. With active participation and engagement in activities, researcher could put objectivity on stake and fails to see the problem as a whole. Suggested methodology focuses on gaining insight and involve users in early phases of interaction design.

For research to be successful it was figured at least two researchers should be present in every session. While participating and engaging with the users, one researcher is involved actively in activities, while the other takes the role of the observer. Still, it is important that the latter is not too passive or acts as a judge or evaluator. S/he should not take notes if not necessary. The analysis happens right after every session when both (all) researchers participate. Researchers switch their roles in each session if possible. Every researcher also leads their own diary.

Experimental study and further work

The proposed methodology is used in an ongoing research that tends to help interaction designers involve, even integrate users in the design process. First phase of the study started at the time of writing this paper. The main focus is on before mentioned kitchen heroes. Semi-closed groups, for example cooking classes, are approached, which enable researchers' pristine engagement with users. Seven women and three men aged between 35 and 55 all middle-class people, using kitchen appliances on a daily basis, were asked for permission to allow researchers to accompany them in part of their everyday activities. In the first part of the research the methodology wasn't explicate to the involved participants. Instead of that, the goal of the ongoing research was explained: to better understand how they operate during their kitchen activities. Participants were surprised with the study goal, as they are not used to be asked about such "trivial" tasks. In the first two meetings broader topic of home appliances and personal information technology (mobile phones, cameras) was touched. It was quickly found out that participants involved were more open and talkative when backed up by other people in similar position. Two of them were part of a joint shopping. Researchers' intention was to experience on what basis the shopping choices are made and how are they connected with kitchen appliances at home.

Now that interaction and collaboration with participants involved in research started, it is planned to continue with the proposed methodology. After the initial observation process is finished, the researchers involved must elaborate on the information and knowledge gained during the first phase. Based on that insight the second phase is planned, where various decisions will be made: how to engage further with the peer community, in which activities and to what extend should researchers participate.

Future work involves regular sessions (once per week) with the selected peer group and regular assessment sessions among researchers. Researchers' intent is to stay open to the peer community for suggestions. Therefore, a more loose, action research approach, where sessions with users are less formal and extremely activity-centered is preferred. Such approach aims for more active participation, eventually leading to participatory design sessions and user-driven innovation process. The research goal remains: to involve those who use kitchen appliances in a fruitful collaborative process, which would result in a model that helps interaction designers and UX architects.

CONCLUSION

Methodology for involving the users in the design process for products was developed and presented in this paper. The developed methodology is a combination of different research methods and techniques and its' dependence on ethnography[8]. It is consisted of three basic parts: observation, active participation and understanding users. The aim of the proposed methodology should answer the research question *how to connect existing devices and how to (re)design them into a ubiquitous system that could be utilized by the vast majority of people, with the focus on kitchen heroes?* Ongoing research that uses the proposed methodology is as well presented in the paper.

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An Ambient Multimedia User Experience Feedback Framework Based on User Tagging and EEG Biosignals

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ABSTRACT
Multimedia is increasingly accessed online and within social networks; however, users are typically limited to visual/auditory stimulus through media presented onscreen with accompanying audio over speakers. Whilst recent research studying additional ambient sensory multimedia effects recorded numerical scores of perceptual quality, the users' time-varying emotional response to the ambient sensory feedback is not considered. This paper thus introduces a framework to evaluate user ambient quality of multimedia experience and discover users' time-varying emotional responses through explicit user tagging and implicit EEG biosignal analysis. In the proposed framework, users interact with the media via discrete tagging activities whilst their EEG biosignal emotional feedback is continuously monitored in-between user tagging events with emotional states correlated with media content and tags.

Keywords
Ambient sensory effects, quality of multimedia experience, tagging, EEG biosignals, social networks.

INTRODUCTION
Readily available Internet-enabled multimedia mobile/camera devices and broadband Internet has resulted in a plethora of multimedia being made available online. Currently, user personal consumption of multimedia is largely through visual media displayed on a screen with accompanying audio (on a mobile phone, tablet, laptop, PC), primarily only stimulating the human audio/visual senses. Recent research has thus considered enhancing a user's Quality Of Multimedia Experience (QoMEX) through ambient sensory effects such as light, wind, and vibration to engage other human senses in addition to vision and audition [10] [11][12].

In addition, recent standardization efforts from the ISO/IEC MPEG community include the Sensory Effect Description Language (SEDL), which aims at compact representation of ambient sensory effect metadata (SEM) for multimedia. Utilising SEDL, Waltl et al. [10][11][12] proposed a test-bed for ambient sensory multimedia experience in the form of a video sensory annotation tool, sensory simulation tool, Sensory Effect Media Player (SEMP) and real test environment using the amBX (amBient eXperience) hardware platform. Subsequent user subjective tests concluded that videos accompanied with amBX sensory effects rated higher Mean Opinion Scores (MOS) than videos without effects over varying bitrates, especially for documentary content (rather than fast action sequences) [11].

Whilst Waltl et al. [10][11][12] utilized a modified MOS metric to measure user QoMEX; even in continuous use MOS provides a numerical score of perceptual quality that does not convey the user's time-varying emotional response to sensory feedback. Thus, this paper aims to extend upon the work of Waltl et al. [10][11][12] to propose a multimedia QoMEX evaluation framework that seeks to collect time-varying user emotional feedback. The proposed framework draws together explicit user tagging activities with implicit user biosignal feedback, such as electroencephalography (EEG) signals that can be directly mapped to human emotional states [1][2]. In addition to evaluating user emotional response to sensory effects, user sensory preferences can also be recorded to personalise the effects depending on the user's content preferences, mood etc. Current methods to derive sensory effects for media content typically present the same effects for each user [10][11][12]; however, in reality, different users are likely to respond differently to varying sensory effects.

The proposed framework builds upon the work of Davis et al. [4], which introduced a social multimedia adaptation framework that utilised semantics derived from user media preferences. In [4], user preferences were inferred from users' interactions with media e.g., tagging media content within social groups/networks. Whilst [4] presented a multimedia adaptation framework, as part of the adaptation process, user QoMEX data and feedback are collected and thus the framework can also be utilized for QoMEX evaluation. This paper hence extends upon the framework of [4] for the evaluation of ambient multimedia

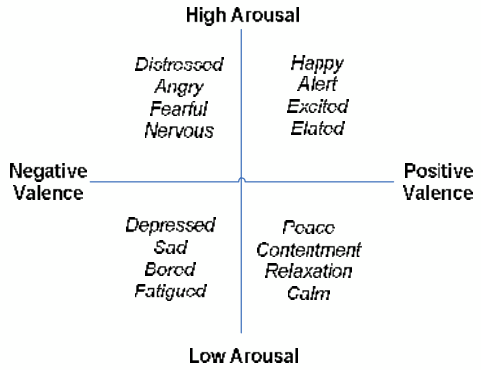

Fig. 1. Valence/arousal emotional space

experiences and collection of user sensory preferences: users explicitly indicate a response through tagging activities whilst their EEG biosignal emotional feedback is continuously monitored in-between user tagging events with emotional states correlated with media content and tags.

BACKGROUND

Emotional feedback for multimedia content is often obtained in the form of user-entered descriptions and tags. For example, on YouTube users can add titles, descriptions and tags/keywords to their videos whilst viewers can comment and tag like/dislike (also available on Facebook). One disadvantage of user-entered tags, however, is tag ambiguities between users [5]. For example, what one user tags as 'amusing' can be tagged as 'happy', 'hilarious' or 'funny' by other users; thus, similar emotional responses often elicit varying emotional tags from users. Further, whilst multimedia tags allow for user-specific emotional feedback, the act of tagging is a deliberate and discrete user-driven event. In contrast, multimedia content and thus corresponding ambient sensory effects can significantly change within a video (and even within a scene). Davis et al. [3][4] found user emotions and responses vary greatly in-between explicit tagging events and thus temporal user emotional feedback is required for ambient experience evaluation, rather than a single score for the entire media clip.

To overcome these constraints of explicit user tagging for capturing user emotional feedback, recent research has shown that user biosignals (e.g., facial expressions, galvanic skin response (GSR), electrocardiogram (ECG), electromyogram (EMG) and electroencephalography (EEG)) can provide valuable multimedia feedback [7][9][13]. EEGs are of particular interest as they are less susceptible to voluntary manipulation (that facial expressions are prone to) and ongoing research suggests that EEGs can directly map to human emotional states [1][2]. In addition, affordable consumer EEG headsets such as the Emotiv EPOC[1] and Neurosky Mindset[2] have

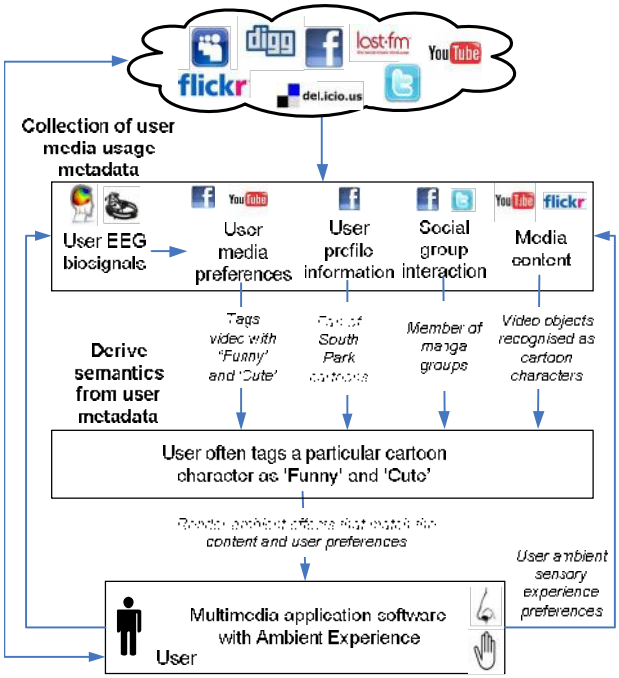

Fig. 2. Proposed ambient sensory feedback framework

recently become available on the market, thus enabling user EEG signal collection in personal computing environments to be of practical possibility.

Yazdani et al. [13] proposed the use of a medical-grade EEG cap for implicit emotional tagging of multimedia, where EEG signals were clustered to form user emotional responses based on corresponding tags. However, the EEG biosignals replaced an explicit emotional tagging interface rather than inferring implicit tags or emotions from the user's real-time physiological response. Various methods to directly map EEG signals to emotional states have been studied: Choppin [2] applied neural network classifiers for three emotional states based on the valence/arousal model from cognitive theory (see Fig. 1) [8]. As shown in Fig. 1, an emotion exists as a point in 2D continuous valence/arousal space, where valence indicates the extent of positive/negative emotion whilst arousal represents the degree of excitement. Also adopting this valence/arousal paradigm, Chanel et al. [1] found EEGs to highly correlate (compared to other biosignals) to emotional states. Thus, as a key indicator to revealing a user's emotional state mapped into continuous valence/arousal space, continuous EEG biosignal feedback is a valid measure to explore for evaluating users' ambient multimedia experiences.

PROPOSED FRAMEWORK

The proposed framework aims to combine and build on the bodies of work discussed in the previous Section to present an ambient QoMEX evaluation methodology based on user tagging and EEG emotional feedback. Fig. 2 illustrates

[1] http://www.emotiv.com/apps/epoc/299/

[2] http://www.neurosky.com/

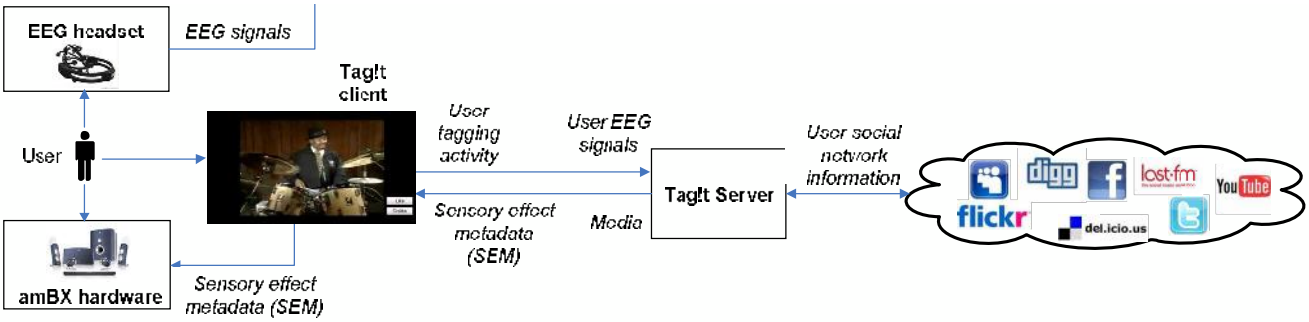

Fig. 3. System flow diagram

the proposed framework extended from Davis et al. [4] to utilise tagging activities combined with EEG biosignal feedback for evaluating ambient multimedia experiences. The framework in Fig. 2 collects user experience-based Quality of Perception (QoP) metadata: analysing the tagging activity whilst consuming media, continuously collecting EEG biosignal responses, and performing content-based media analyses. Due to the prevalent sharing and consumption of media via social networks, additional metadata can also be collected from the user's volunteered profile information and interaction on social networks to further build up knowledge about the user's preferences. Fig. 2 loosely groups the different metadata types into four categories [4]:

- User media preferences e.g., video interaction (start/stop/pause etc.) and tagging (like/dislike/funny etc.), augmented with EEG biosignal feedback as proposed in this paper;
- User profile information e.g., from social networks;
- Social group interaction e.g., collaborative tagging activity, sharing of multimedia content; and
- Media content-based metadata e.g., signal processing analysis.

Whilst tagging within this framework was explored in [4], this paper introduces continuous EEG user emotional feedback (e.g., using consumer EEG headsets) to map user emotional responses to tagging activity and media content in response to ambient experiences.

SYSTEM IMPLEMENTATION

The authors are implementing the ambient QoMEX evaluation framework of Fig. 2, and the system flow diagram is shown in Fig. 3. Utilising presently available technologies, the implementation involves consumer EEG headsets with accompanying SDKs (Emotiv EPOC and Neurosky Mindset), the amBient eXperience (amBX) computer peripheral hardware and SDK (as used by Waltl et al. [10][11][12])[3], and a modified version of the Tag!t tagging client/server technology tool [3].

As shown in Fig. 3, the user views videos using the Tag!t client interface, which communicates with the Tag!t server to send user tagging activity and EEG signals (interfaced to the EEG headset). The Tag!t client receives ambient sensory effect metadata (SEM) from the Tag!t server, and renders the effects on the amBX hardware through the amBX API.

EEG Signal Collection

Utilising the headset SDKs, the user's EEG signals (or emotional states predefined for the headsets) are periodically polled each second and collected for analysis. The single-sensor Neurosky Mindset, in addition to access to raw EEGs as delta, theta, alpha, beta and gamma waves, defines two emotional states using propriety algorithms: attention (i.e., focus) and meditation (i.e., calmness). Similarly, the 14-sensor Emotiv EPOC provides access to the raw electrode signals, facial expression sensing (via facial muscle EEGs), cognitive thought sensing, dual-axis gyroscope (for head movements) and five emotional states defined using propriety algorithms: engagement/boredom, meditation, frustration, and short and long-term excitement. Whilst initial studies can utilise the emotional states predefined in the headset SDKs, the framework aims to support directly mapping EEG signals to varying emotional states building on learning classification techniques [1][2].

Ambient Multimedia Effects Rendering

The amBX hardware is composed of one rumble wrist pad with two variable speed motors, two fans of variable speed control up to 5000 rpm, two 40W speakers with LED array satellite lights, 80W subwoofer, and high power LED wall-washer lights of 3 LED arrays capable of over 16 million RGB colours. The Windows SDK for the amBX hardware is freely available, and allows for direct control of the amBX hardware via the API by parsing the sensory effect metadata (SEM) sent from the Tag!t server.

amBX effects can either predefined and stored on the Tag!t server or media-specific effects derived in real-time though content analysis algorithms running on the Tag!t server (see Fig. 2). For the preliminary evaluations of the proposed framework, amBX effects are predefined and generated offline. Different colour effects corresponding to video content are derived based on average frame colour and dominant frame colour, as obtained through colour

[3] http://www.ambx.com/

```
<SEM>

   <GroupOfEffects si:pts="57" duration="200" fade = "30" position = "urn:mpeg:mpeg-
   v:01-SI-PositionCS-NS:center:*:front">
       <Effect xsi:type="sev:LightType" intensity-value="0.5478" intensity-
       range="0.0000 1.000" color="#808080 />
       <Effect xsi:type="sev:WindType" intensity-value="0.2061" intensity-
       range="0.0000 1.000" />
       <Effect xsi:type="sev:VibrationType" intensity-value="0.1467" intensity-
       range="0.0000 1.000" />
    </GroupOfEffects>

   <GroupOfEffects ...>
       <Effect ... />
   </GroupOfEffects>

</SEM>
```

Fig. 4. Example SEM

Fig. 5. Screenshot of Tag!t client interface

histograms [10]. Whilst light effects are continuous for all video content, wind (fan) and force feedback (rumble) are manually derived for relevant video content.

Sensory Effect Metadata

Sensory Effect Metadata (SEM) is represented using the Sensory Effect Description Language (SEDL), currently undergoing standardisation in MPEG-V Part 3 [6]. For flexibility, sensory effects, which can be application-dependent, are not defined in SEDL but within a Sensory Effect Vocabulary (SEV).

SEDL is an XML schema-based language, an example SEM for amBX hardware is shown in Fig. 4. For brevity, a series of effects for a given timestamp (`pts`) can be defined in a `GroupOfEffects` element. All attributes are inherited by the child `Effect` elements e.g., `duration` and `fade` times, and `position` of the effects. For the amBX API, device intensities are restricted to a floating point range of 0 to 1, hence the `intensity-range` and `intensity-value` attributes shown in Fig. 4.

Tag!t User Client Tagging Interface

The collection of user media tagging metadata requires a tagging interface tool, developed as 'Tag!t' by Davis et al. [3]. Tag!t has been modified by the authors to additionally collect and send EEG signals from consumer headsets, with an example interface screenshot shown in Fig. 5. Tag!t is a client/server application that allows users to tag multimedia directly from their client, be it a web browser or standalone Tag!t application, where the user is presented with a video and a separate tagging panel (see Fig. 5). Whilst the example interface in Fig. 5 supports like/dislike tagging akin to the like/dislike video user interaction on YouTube and Facebook, Davis et al. [3] have studied the use of emotion tags ('emotitags'), prompted tagging, different tagsets and user-defined tags.

Tag!t Server-Side Processing

The Tag!t server is configured in a Linux, Apache, MySQL and PHP (commonly known as LAMP) environment and implemented using the Recess RESTful PHP framework. All user tagging activity and EEG data from the Tag!t client are sent to the server and saved into a database. As the media file is streamed via the Tag!t server (see Fig. 3), the amBX effects metadata can either be retrieved from predefined SEM files or derived in real-time based on media content analysis (see Fig. 2) and delivered to the amBX hardware via the Tag!t client.

DISCUSSION AND EVALUATION

To evaluate the proposed framework, the key research questions aim to discover users' time-varying emotional responses to ambient multimedia experiences. Whilst Waltl et al. [10][11][12] showed that users do enjoy amBX effects, how does the quality of experience vary within a video, would users prefer parts of videos containing certain content to render more or less effects, at what rate of change do effects cease to improve ambient QoMEX and become annoying/unpleasant, and how to effects preferences vary with corresponding modality (i.e., video/audio stimulus)? Further, building on the social multimedia findings of Davis et al. [3][4], the proposed framework (see Fig. 2) can also investigate whether users

Fig. 6. Example amBX evaluation

exhibit shared sensory preferences within social groups e.g., are users who are fans of horror movies likely to enjoy added thrilling sensory effects, whereas other users may not desire the additional suspense?

Typically, for QoMEX evaluation experiments to investigate the research questions above, users will be instructed to watch a series of videos with and without ambient sensory effects, and asked to tag at any point during the videos whilst wearing an EEG headset. EEG signals are continuously recorded with all tagging activity and EEG data sent to the Tag!t server for processing and evaluation. Fig. 6 illustrates an example user evaluation setup using the Emotiv headset, where the room lighting has been accentuated for visibility; hence, the amBX lighting effects appear muted. Whilst the user is seated quite close to the amBX and video stimulus in Fig. 6, different audience distances will be investigated to discover 'optimal' distances for experiencing near-field ambient effects such as the wind/fan, and far-field effects such as the wall-washer lights.

By collecting and evaluating users' ambient QoMEX, user preferences can also be gauged from their emotional response to effects and thus QoMEX improved by personalising effects and adapting multimedia according to media content preferences, the user's emotional state as detected from their EEG signals, or according to their social group preferences. Further, shared ambient sensory preferences among members of social groups can help to build a QoMEX preference profile for new group members.

CONCLUSIONS AND FUTURE WORK

This paper introduced a framework to evaluate time-varying user emotional responses to ambient quality of multimedia experience. In the proposed framework, users explicitly indicate a response through tagging activities whilst their EEG biosignal emotional feedback is continuously monitored in-between user tagging events with emotional states correlated with media content and tags. The proposed framework also supports the collection of user sensory preferences for ambient effects personalisation, in addition to exploring sensory preferences shared among social groups. The authors are currently implementing the framework with readily available consumer EEG headsets, amBX sensory effects hardware and client/server user tagging software tools; a number of user evaluation experiments will shortly follow.

ACKNOWLEDGEMENTS

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“Design Thinking” in Media Management Education – A Practical Hands-On Approach

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ABSTRACT
Within the scope of this paper, we describe a practical hands-on approach of applying “Design Thinking” as principal teaching method for a university course. The course was established as part of the media management minor at the EMMi Lab., at the Tampere Univ. of Technology. The course was held in cooperation with the Tampere University (UTA), and the Tampere University of Applied Sciences (TAMK) at the premises of the New Factory (Demola), an innovation facility in Tampere, Finland. It shall train students in the development of innovations in the media field, and foster creative thinking methods. We discuss the basic curriculum, course structure, methods utilized in the course, as well as we present a reflection on the course in the discussion section.

Keywords
Design Thinking, Learning Methods, Ambient Media, Learning-By-Doing, Media Management, Teaching

INTRODUCTION
Design Thinking can be roughly described as a method for the creative development of products, services, or other relevant tangible or intangible matters requiring a creative mind for the development of novel ideas. Design Thinking is a new method for bridging “Rational Thinking” and “Artistic Thinking”. It aims to foster a consumer oriented approach in product or service development by fostering creative thinking. Design Thinking is multidisciplinary, and requires a though through process during performing its stages and processes.

During the preparation phase of the course we faced many challenges:

- right setting, right feeling, and environment for holding a design thinking course;
- provision of the right course and background materials to train students;
- creating the right balance of students with various backgrounds and specializations;
- providing the right tools and training for students to support students in the design thinking phases;
- making students aware about the method design thinking and how design thinking differs from other;
- selection of methods and techniques to support students in each phase of design thinking to complete their tasks.

Figure 1. Open Space Environment for the Design Thinking Lectures (Demola Premises)

The method “Design Thinking” has been adopted for the course entitled “Frontiers of Media Management” organized by the Entertainment and Media Management Lab. (EMMi Lab.) for the media management minor in the study year 2010-2011 at the Tampere Univ. of Technology (TUT). The course had an extent of 8 ECTS and was established as blocked course, with specific workshop times with additional homework and project work for students. The course was held at the Tampere New Factory (Demola) premises, which is an open space to foster creative thinking and innovations in Tampere region (see Figure 1).

Figure 2. Design Thinking Phases

Figure 2 gives a brief overview of the phases of a Design Thinking cycle. The main issue is to empathize with the

consumers, to get known to their wishes and desires. After this the actual problem to be solved can be defined and framed. The most significant phase is the ideate phase, where a solution for the problems are sought. This solution is prototyped, and tested with consumers to gain insights in their feedback. If flaws are discovered, the full design thinking cycle can be run-through again. An overview of the different phases and it's goals can be found in Table 1 (from [8]).

EMPATHIZE	**Observe Engage**	Understand and empathize with the consumer What needs and desires do users have Identify for whom do design for Which emotions to trigger/guide the consumer What are the thoughts and values Which kinds of stories do they tell How do people act in situations What helps us to know their experience • **What do people do?** • **What do people think?** • **What do they need?**
DEFINING	**Actionable Problem Statement Focus**	Provides focus and frames the problem General vision for the group Reference for evaluating ideas Guides the innovation efforts Fuels brainstorming – "how can we solve...." One solution for one group of people Not many solutions for everything Inspiring people of what you do
IDEATE	**Flaring Going wide for concepts/outcomes**	Source for prototypes Step beyond obvious solutions Team creativity Unexpected areas for exploration Wide range of innovations Beyond obvious solutions Pushing the team brain boundaries • **Sketches, scenarios, stories, involve consumers, tell stories, PowerPoint, ...**
PROTOTYPE	**Rapid Building Consumer Tests**	Quick and rapid prototyping Learning about failures Conversations with a real object Testing and improving possibilities Solution based process
TEST	**Real Life Testing Re-Definition**	Letting consumers interact – don't tell Observation Improvement of prototypes Particular prototypes should answer concrete questions Find out latent and new needs

Table 1. Overview of the Design Thinking Phases (compiled and excerpted from [8]).

The goal of this paper is to describe a practical approach to develop Design Thinking courses in form of a hands-on approach towards organizing and scheduling a Design Thinking course for students. It describes administrative issues, potential scheduling of practical lecture events, homework for students, challenges, suggested background literature, pitfalls, and potential discussion themes. The paper rounds up with a discussion of the course from the teachers and student perspective. For prospective teachers we especially advice [8] and [7] as basic readings.

COURSE STRUCTURE AND DESCRIPTION

Objectives of the Course

The objective of the course was to cope with latest trends in entertainment and media management. Skills for problem solving within a cross-disciplinary team shall be learned. Especially in media industries, the continuous creation of innovation and new products is major concern, due to the short product cycles. This objective of this course was to apply Design Thinking in the idea generation phase and empathize with the way how designers think. But it's not solely about designing things, it's also about idea generation and creative thinking. This course especially devoted to innovations in media industry, and especially how ideas to improve media products can be generated. Teamwork, consumer oriented thinking, and creating business out of these ideas is in the foreground of this course. The challenge for students is to generate new ideas in the field of ambient media. Ambient media – or also referred to as ubiquitous media – are media that are embedded throughout the natural human environment. Examples are smart homes, location based services, or smart wallpapers. However, the main aim is to train participants in the method of design thinking by exploring industrial challenges around the topic ubiquitous / ambient media together with industrial partners.

Learning Events

The course was arranged in 5 teaching units, where each event had a duration of up to 4-5 hours in form of practical works, presentations, and workshops. The first event was of shorter duration, as solely practical matters where discussed. Between each learning event, students had to do homework which they had to organize by themselves. Each homework amounted to approx. 8 hours.

The different learning events followed the phases of the overall design thinking cycle. The "empathize phase" was performed in form of a student homework (homework 3). Within one lecture the "define" and the "ideate" phase has been performed in form of a workshop during the lecture. The "prototype phase" was performed in form of student homework (homework 4). Due to a lack of time, the "test phase" could not be performed within the scope of this course, but was replaced by a homework exercise (homework 5), where students had to evaluate, reflect, and develop a business plan.

Course Attendees

The course has been attended by students with various backgrounds from three universities: Tampere Univ. of Technology (TUT), Tampere University (UTA), and the Tampere University of Applied Sciences (TAMK)[1]. A total of 11 students participated in the course, where 7 where originally from TUT, 2 from UTA, and 2 from TAMK. From these students, 2 students were enrolled for BSc. studies, 8 students to MSc. studies, and 1 student on post-doctoral level. The background of the studies varied, and ranged from psychology (1), business (3), media management (2), human-computer-interaction (1), and IT (4).

Teaching Location

The teaching location had to differ from the daily university environment, and provide the facilities for applying Design Thinking as teaching method. It should be an opened space, providing a suitable atmosphere for fostering creative thinking. We selected the premises of the New Factory (Demola) in Tampere city[2]. The premises were established as open innovation space for Tampere region. Figure 2 presents a table within the open innovation space.

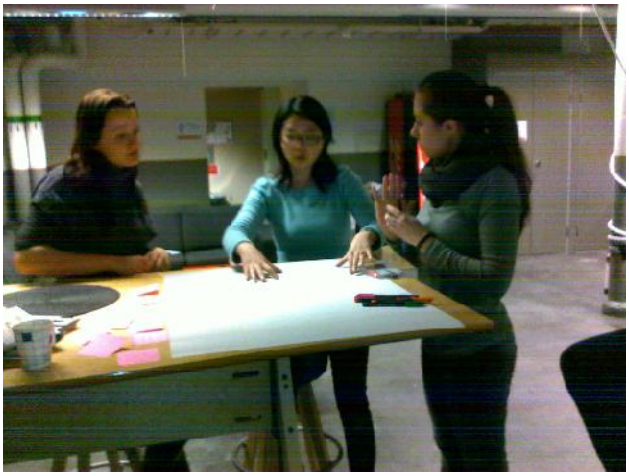

Figure 2. Students Discussing their Ideas.

IT Infrastructure and Resources

From the IT infrastructure the course was rather simple organized, and it's main tools were an online moodle, email lists and software tools (e.g. PowerPoint, Adobe Photoshop) used to develop mockups and first prototypes. Sufficient workshop materials, such as different colored/shaped postix, colored paper, colored pens, glue, and other office materials have been supplied.

[1] See www.tut.fi/emmi, www.uta.fi, and www.tamk.fi.

[2] See www.demola.fi

DESCRIPTION OF LEARNING EVENTS & LECTURES

Lecture Schedule and Structure

Within the scope of this section, the general layout of the course lectures is presented. The course was divided into five learning events with different objectives and working methods. The initial goal was that each learning event (except the one of the first lecture) would be 4-5 hours, but several sessions have been prolonged due to the amount of group works, exercises, and presentations.

Literature & Handouts

The course offered a wide range of background literature and resources for self-learning presentations. Within the scope of this section the background material is presented.

Basic course literature that had to be read by all students:

- chapter 1 of the text-book [25], [3], chapter 1 and chapter 7 of the text-book [15], [8], [5], [14], [18], and [22].

Literature for student self-learning presentations:

- General design thinking overviews: [8], [5], [15], [14], [18], and [22];
- Media and innovation: chapter 1, 4, 8 of the text book [25], chapter 1 and 2 of the text book [15]
- Design Thinking training and education: bootcamp information [8], and practical cases in [7];
- Consumer research, experience, and ethnography: design ethnography [2] and [20]; experience prototyping [6]; design toolkits [1]; empathy and experience [24]; and empathy and probing [16], [11], [23], and [19];
- Business and management applications: chapter 4 of [15], [9], [10], readings from [12], and [13];
- Application areas for Design Thinking: social applications [4] and general thoughts how to apply the method [17].

DESCRIPTION OF TEACHING EVENTS

1st Lecture – First Gathering (approx. 2 hours)

- **objective:** general introduction, gathering of interested students, forming of groups, and division of presentations;
- **content:** presentation of the general course goals, administrative issues, scheduling of learning events, and presentation of student presentation topics;
- **homework 1 (self-learning presentation):** preparation of general presentations about design thinking within student groups;

The first gathering should bring students together, and get known to each other. The topics for the student presentations in the second lecture were assigned.

2nd Lecture – Student Presentations and Design Thinking "Test-Run" (5 hours)

- **objective:** presentation of the theoretical aspects of design thinking and performing a design-thinking test-run to train students in the new method;
- **content:** student presentations of background materials about design thinking, general discussions about the method, design thinking 'test-run', and division of design thinking challenges;
- **method:** student presentations (10 minutes plus discussion/presentation topic), acquisition of the essential knowledge how to perform design thinking as a creativity method in a learning by doing style;
- **homework 2 (design thinking 'test-run' report):** compilation of the results of the design thinking test-run into a report;
- **homework 3 (user-study):** preparation of a user-study via interviews, observation of the design thinking challenges to understand and conceive the actual problem by selecting a method from ethnographic studies;

Design Thinking "Test Run"

A small introduction at the beginning should introduce students to each other with a small warm-up game. It should relax the atmosphere to build two teams. In this phase it is very important to divide students according their background and place them in multidisciplinary teams to enable an opened environment.

The aim of the 2nd lecture was to introduce the concept of Design Thinking to students in learning-by-doing fashion. As the concept of the course was based on practical works, a small design challenge that could be performed within a 3 hours has been given. The challenge was to improve the facilities for the people working in the opened space where the course took place: *Demola is an opened space fostering creativity and thinking beyond the edge. How can the space be created more creatively and friendly for the people working here with ubiquitous media?*

Students had to observe and interview the workers of the open space, and develop paper mock-ups how the environment could be made more innovation friendly. Several phases of Design Thinking have been gone through and the theories of the phases were explained through self-experience and reflection of each Design Thinking phase. As result, students had to create a report how to improve the innovation space and how to create a new experience for the employees. Table 2 presents the schedule for the "Mini-Design-Thinking" session, and Figure 3 shows the 'prototype' of an improved opened space for an innovation environment.

16:15-16:30 Introduction
(10 minutes) Warm-up Game 'introduce each other'
Form teams (multidisciplinary, with 'strangers'...)
16:30-17:30
(5 minutes) Challenge Presentation
(55 minutes) Observe & Interview
17:30-18:20
(10 minutes) Introduce Point –of-View
(10 minutes) Define Common Point-of-View
(30 minutes) Ideate
18:20-19:00
(60 minutes) Prototype
(30 minutes) Presentations

Table 2. Schedule for a 'Mini-Design-Thinking' Session.

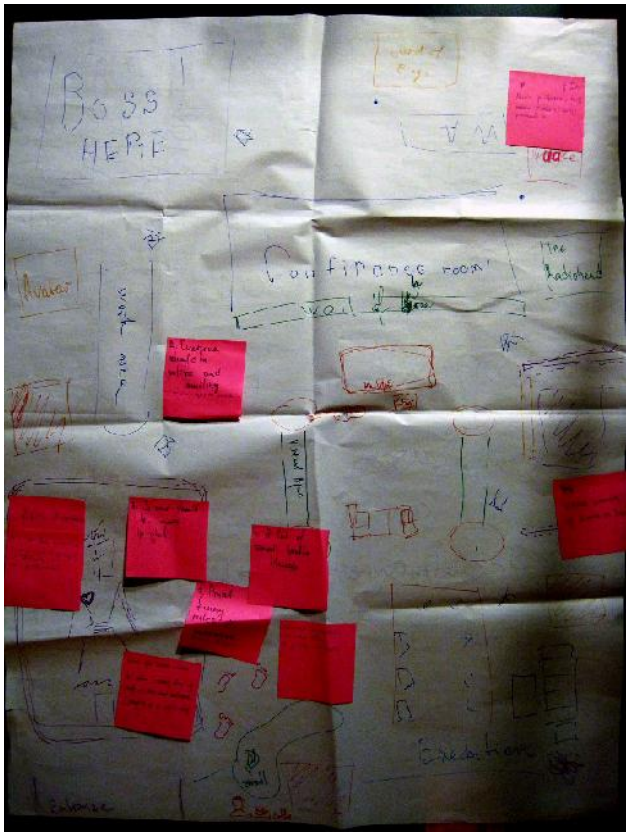

Figure 3. 'Prototype' of an Improved Open Space for Innovations.

Ethnography Based User Study

Especially for the user-study it was essential to investigate methods that are simple enough for being taught to students for completing their tasks. They should be well suited to understand the consumer, stimulate unexpected findings, be flexible enough, be holistic, allow a contextual inquiry, and

fit to the phases of the Design Thinking methodology. Therefore we focused on the collection of ethnographic holistic methods that allow precise documentation and planning and can act as guidelines for observing, defining, and framing the underlying problem. In literature keywords would be "holistic design", "design probes", "contextual inquiry", "experience prototyping", or "design ethnography". For investigation of these methods, we pinpoint to the following literature resources as reference: [1], and [21]. These resources acted also as literature for student for investigating these methods and should apply in the empathizing phase, as well as later in the evaluation phase.

Figure 4. Presentations Held During the Course.

Within the scope of this course, we utilized the IDEO HEAR toolkit during the empathizing phase. It helped the students to ponder the implications of their ideas in further detail with the help of the other supplied background literature. As students varied in backgrounds, it was clear, that a first time ethnographic study will by far be perfect. The intention of this homework was rather to familiarize students in the way how to perform the task as such. The given references acted as basis for discussions what was helpful, insightful, hindrance, or boring in addition to the actual results and the process. The approach was to revise what has been done in further depth, and how to apply these techniques better in future studies.

Introduction of Design Thinking Challenges

At the end of the course, three design challenges have been presented, as illustrated in Table 3. Students were divided into two groups, and each group at to select one challenge (challenge 1 and challenge 2 were selected). As homework, students had to empathize with the consumers and create an evaluation from the consumer viewpoint by applying the methods mentioned above. The results had to be presented in the following lecture. To avoid any straightforward solutions, the challenges were designed to restrict the idea finding (e.g. no mobile solutions or no public screen solutions were allowed).

DESIGN CHALLENGE 1

- **SHOPPING**
  ambient media are media embedded throughout the natural environment. How can the shopping experience *(keywords: finding, navigation, payment, personalization, advertising …)* for consumers increased with this technology for IKEA (NO mobile phones and public screens allowed!)
- **Documentation:** pictures, notes, method, additional materials, report, presentation …

DESIGN CHALLENGE 2

- **URBAN KIOSKS**
  ambient media are media embedded throughout the natural environment. In the future more and more urban kiosks at city points will be available allowing communities to exchange information *(keywords: communities, live-events, information exchange, urban computation, co-creation of media, polls, navigation, leaving memories, exchanging personal content).* How can the urban 'phone cell' of the future look like? Check out meeting points, museums, public events, …
- **Documentation:** pictures, notes, method, additional materials, report, presentation …

DESIGN CHALLENGE 3

- **CINEMA**
  ambient media are media embedded throughout the natural environment. How can the experience *(keywords communities, live-concerts, co-operation, advertising, public advertising, navigation, 3D)* for consumers increased with this technology for cinema visitors as e.g. Finnkino (please NO DULL mobile phone services or NO DULL public screens!)
- **Documentation:** pictures, notes, method, additional materials, report, presentation …

Table 3. Design Challenges Given as Home Work.

3rd Lecture – Presentations, Point-of-View, Common Point-of-View, and Ideate (5 hours)

- **objective:** presentation and discussions of user evaluations, and performing the other phases of design thinking as workshop;
- **students:** presentations and discussions of user evaluations, and performing the other phases of the design thinking phases;
- **trainer:** presentation and overview of the goals of each design thinking phase and methods applicable for the ideation phase;
- **methods:** presentations, discussions, and creative workshop organization;
- **content:** performing the core phases (individual point-of-view, common point-of-view, ideate) and discussion of the results with all the course members;

- **homework 4 (prototyping and presentation):** preparation of a user-study via interviews, observation of the design thinking challenges to understand and conceive the actual problem by selecting a method from ethnographic studies;

- **16:30-17:30** Presentations of student homework (Point-of-View) - **17:30-17:45** Define Common Point-of-View - **17:45-18:00** Checkups: Present Common Point-of-View - **18:00-19:00** Ideate - **19:00-19:30** - Present Ideate results

Table 4. Schedule for the Practical Design Thinking Workshop.

The idea of this lecture was to assist the students in creating their projects and evaluate their project ideas. The goal is the development of a concise plan for the prototypes, as well as to what qualities should be prototyped, and how the groups will approach the task. This should include what features or aspects of the selected challenge and ideas the prototype should represent. One of the main considerations was, that the prototype had to be developed for an explicit reason, that the student homework stays focused and motivate the involved parties. Table 4 presents the schedule for this lecture, and Figure 5 and Figure 6 show the student teams working on their preliminary prototypes.

Figure 5. Prototyping Phase.

As homework (besides the prototyping as such), students had to reflect on the prototype development, and present the results in form of a presentation in the following lecture. The presentation had to include:

- What is prototyped (clear description)?
- Who is the intended/expected consumer of the prototype?
- For which purpose and for what features/aspects of the challenge or solution are sought to be explored?
- What did the teams learn and reflect from the particular prototype?
- What were the most useful things of the prototype and how did they affect the change of the perception of the challenge or its characteristics?

4th Lecture – Product Idea Presentation and Evaluation (5 hours)

- **objective:** gathering of interested students, forming of groups, and division of presentations
- **content:** student presentations of background materials about design thinking, general discussions about the method, design thinking 'test-run', and division of design thinking challenges
- **homework 5 (final report an diary):** students had to complete a final report in form of a learning diary reflecting the design thinking process and presenting a short business evaluation of their ideas;

Figure 6. Prototyping Phase.

The last homework of students was to complete a written final report, which had to answer a few questions to enable them a reflection on the learned. A sort of kind of learning diary is an efficient method to enable a pragmatist inquiry. The follow-up reflection of the practical experiments, workshops, and learning sessions shall lead to reconstruction and learning. The report was structured into three part: development process of the concept, group processes, and a small scale business part. The design thinking phases acted as structure for the report. The questions that students had to answer were:

Development process of the concept:

- Why was the concept developed?
- What challenges or opportunities did it address?
- How was the concept developed?
- How was the development undertaken by the group?

Reflection on team functioning and processes:

- What do you consider the most critical/definitive stages in the team work?
- How did your perception of the challenge/concept change during the process and why?
- How could the methods, tools, and insights gained during the project be utilized for new product development?
- How do human centered/design centered approaches differ from usability or HCI methods in new product and service development and why?
- Why is the human/design centered approach significant in innovation, and why is it not important?
- In which kind of situations or challenges would a systematic/open approach work the best and why?

Business evaluation of the product:

- Describe your idea in general teams in form of a product pitch.
- What are the business benefits for the business partner of your product?
- Describe the market, its structure, restrictions, major players, entry barriers, and layout.
- How can the idea be monetized?
- What would be your market launch strategy, and the strengths and weaknesses of your product/service (e.g. SWOT analysis)?
- How would you organize your firm internally and create links to external stakeholders/business partners?
- Which resources would be needed to monetize/market the product or service?
- How can the service/product be maintained and which resources would be required?
- Could you please outline a very simple financial plan for your product/service?
- What would be a preliminary time-plan for the first years of your newly launched company?

5th Lecture – Guest Lecture with Practical Work and Course Roundup (5 hours)

To round-up the course, a guest lecture with the theme "Marketing with Social Media" has been held. The lecture should help students to get a glimpse how their product can be marketed via social media tools. This lecture was accompanied with a small practical group work, where students had to develop an advertisement concept. The lecture was more of a round-up type and should conclude the course.

DISCUSSION

From the student perspective:

- Versatile, intercultural groups, with different educational background improving teamwork and knowledge exchange;
- Meeting of new friends and collogues with different viewpoints and uncommon ways how to solve problems;
- Relaxing atmosphere letting new ideas emerge and creativity flow, especially learning new perspectives within the scope of a non-lecture like course.

From the teacher perspective:

- Clear clarification of the various Design Thinking phases and outlining a structure for the Design Thinking process especially in the idea finding phase (tendency to find solutions rather than develop their ideas further, define the problem, or empathize with the consumer);
- Creation of an opened, relaxed, and vivid atmosphere to foster creative thinking and team work;
- Training awareness about consumer needs, rather than letting students focus on solutions or their own ideas – creation of an understanding to empathize with the consumer, or the ideas rather than thinking about solutions;
- Emphasize on the creation of awareness for holistic viewpoints from society, technology, and consumer viewpoints – thinking beyond the limitations;

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