Lugmayr, Artur; Serral, Estefanía; Scherp, Ansgar; Pogorelc, Bogdan; Mustaquim, Moyen

Article

Ambient media today and tomorrow

Multimedia Tools and Applications

Suggested Citation: Lugmayr, Artur; Serral, Estefanía; Scherp, Ansgar; Pogorelc, Bogdan; Mustaquim, Moyen (2014) : Ambient media today and tomorrow, Multimedia Tools and Applications, ISSN 1380-7501, Springer Science + Business Media B.V, Dordrecht, Vol. 71, Iss. 1, pp. 7-37, https://doi.org/10.1007/s11042-012-1346-z

Multimed Tools Appl
DOI 10.1007/s11042-012-1346-z

Ambient media today and tomorrow

What have ambient media in common? What are ambient media today? Where will ambient media be in 2020?

Artur Lugmayr · Estefanía Serral · Ansgar Scherp · Bogdan Pogorelc · Moyen Mustaquim

Abstract Ambient media are novel, and this new media form alters our daily-living experience in many ways. Ambient media refer to media environments that are embedded throughout the natural space where people are following their daily activities. These digital media environments become part of the living space and altering our daily-living experience in many ways. The goal of this article is to elaborate the status of ambient media today and to forecast how ambient media will develop in the next decade. It clearly identifies megatrends and develops scenarios (e. g., ambient-assisted living) for the future. These scenarios shall shed light on the potentials and give a glimpse on the potential future development of embedding digital objects into the daily living space. This paper is based on a future wheel

E. Serral
Christian Doppler Laboratory for Software Engineering Integration for Flexible Automation Systems, Technical University of Vienna, Wien, Austria
e-mail: estefania.serral@tuwien.ac.at

B. Pogorelc
Department of Intelligent Systems, Jožef Stefan Institute, Jamova c. 39, 1000 Ljubljana, Slovenia
e-mail: bogdan.pogorelc@ijs.si

B. Pogorelc
Špica International d. o. o, Pot k sejmišču 33, 1231 Ljubljana, Slovenia

B. Pogorelc
Jožef Stefan International Postgraduate School, Jamova 39, 1000 Ljubljana, Slovenia

A. Lugmayr (✉)
EMMi Lab, Tampere University of Technology (TUT), POB. 553, FIN-33100 Tampere, Finland
e-mail: lartur@acm.org
URL: www.tut.fi/emmi

A. Scherp (✉)
University of Mannheim, B6, 26 Room B1.14, 68131 Mannheim, Germany
e-mail: scherp@uni-koblenz.de
URL: http://www.ansgarscherp.net/about/

M. Mustaquim
Department of Informatics and Media, Uppsala University, Box 513, 751 20 Uppsala, Sweden
e-mail: moyen.mustaquim@im.uu.se

Published online: 23 February 2013

approach and on an analysis of the results of an expert workshop. The article concludes with a discussion of the results and an evaluation of the impact of each scenario.

Keywords Ambient media · Ubiquitous computation · Pervasive computation · Human-computer-interaction · Ambient assisted living · IPTV · Shape shifting media · User experience · Smart environments · Smart cities · Smart urban environments

1 Introduction

The key theme of this article is to analyze the state-of-the art of ambient media. To this end, it especially focuses on the following research questions:

- *What do ambient media have in common and what are ambient media today?*
- *How can ambient media develop in the future given the current state-of-the-art?*

Ambient media today are clustered. Many new services such as location-based services, ambient-assisted-living solutions and new artistic approaches emerge. As ambient media can be seen as a revolution that takes place in the background and consumers are currently not aware that these are ambient services, it is challenging to draw a clear outline what ambient media environments actually are. It is also difficult to define how they will impact the consumer experience, especially when digital services overlaying real-world spaces converge with daily-living activities. The challenge therefore is to analyze what ambient media services are today and how they might develop in future.

Figure 1 depicts the various aspects of ambient media that have been considered and discussed in an expert workshop. The easiest approach is to analyze ambient media from a

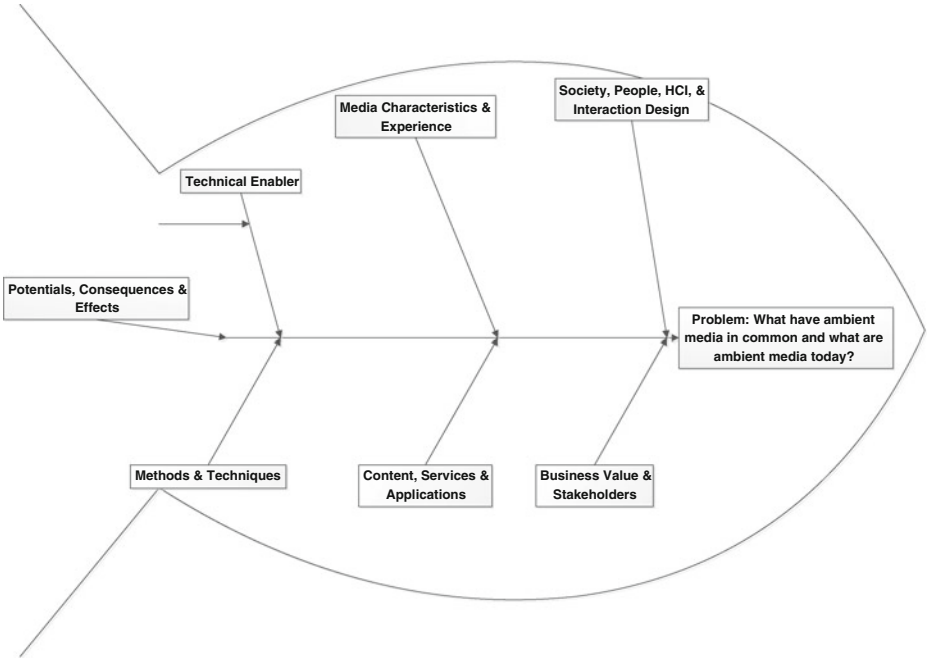

Fig. 1 Fishbone (cause-effect) tool to identify the current state of ambient media (after [5])

technical-enabler and methods and techniques point of view. Many are already available in research laboratories or in industries. However, as soon as we discuss ambient media from a media-characteristics and consumer-experience point of view we have more and more difficulties as ambient media are an innovation that is hard to grasp for end-consumers. The discussion around content, services, and applications seems to be an easier one. But as ambient media are a new form of media also the notion of content will be changing. So far media existed within the scope of easily distinguishable forms such as TV sets, newspapers, or cinema screens. As ambient media distributes its media objects throughout living spaces such as kitchens or public spaces, the borders between content, applications, and services are more and more blurred. However, also the borders between physical, real-world objects blur. Ambient media require a new way of thinking in terms of the development of media objects. In addition, multi-disciplinary teams involving designers, experience experts, engineers, and business people are required to develop them. A living space simply requires more than a technical solution—it requires the creation of an experience, which is only possible with knowledge of several domains.

In addition, media have an impact on society and transforms societies, the way how we collaborate, and how people interact with technologies. This is another problematic issue in discussing the notion of ambient media. It goes in line with discussing the business prospects of ambient media. Ambient media content and ambient media services are innovations and like each innovation they are tricky to deal with in the context of commercialization. All these points require a systematic analysis, especially a thorough discussion of what ambient media are today and which characteristics they have in common. Giving a future prospect on how they might be developing has a direct impact on their development, especially when discussing the impact on society or business development.

Before elaborating on the existing factors influencing ambient media we reflect on the current research problems, the current status quo, and literature, in which this is discussed:

- not powerful and accurate enough approaches for detecting health care problems or managing health care services (e.g. [70] or [29]);
- alternatives for sharing human knowledge rather than existing Internet services as Google or Facebook (e.g. [62]);
- utilization of legacy hardware, software, terminals and home technologies in ambient media services supporting services in healthcare or assisted living (e.g. [73]);
- computational power easy backend services and lack of existing solutions for specific problems by utilization of ambient services;
- fat client approaches and terminals rather than thin and fast client approaches to support adequate user experiences (e.g. [24]);

1.1 Method and approach

The development of an adequate method to explore how ambient media might develop in the future requires much skills and thoughts. As the goal is to examine existing research materials and literature qualitatively, the approach has to be well-developed. To cope with this challenge, we based our method on the basis of a method that was developed within the scope of the *Next Electronic Media (NELME)* project, whose research topic was the exploration of how television might develop in the next years. A modified method of Ville Ollikainen has been used within the scope of this work (see [64]). The process of the method has the following major steps:

- **Organization of an expert workshop** in the form of a scientific workshop to collect expert knowledge and a basic view to the field of ambient media (workshop results see [48]). The expert group was composed based on workshop papers, and carefully selected. The profile of the participants emerged from academia. However, a few were coming from industrial R&D laboratories.
- **Fishbone tool** [5] **to identify the cause-effect chain of ambient media.** The fishbone method was applied in the workshop with the goal to solve the particular problem of what ambient media are today and what ambient media have in common (see results documented in Fig. 1). The goal was to explore the phenomenon of ambient media and identify the cause that led to this development. The fishbone or cause-effect tool was the right approach towards stimulating the discussion to explore the space problem. It should help to illustrate the current state of ambient media and the factors that contribute to ambient media in a wider context.
- **Identification of the current state of the art** by analyzing the results of the scientific workshop, expert discussions in the workshop, and the cause-effect relationships. In addition, finding the key-contributors for its development on various levels: technical enabler; media characteristics and experience; society, people, human-computer interaction, and interaction design; business value and stakeholders; content and services; and methods and techniques.
- **Development of scenarios for ambient media based on key-signals.** The goal after the development of the state-of-the-art was the development of top-level scenarios how ambient media is used today and potentially in the future. These scenarios (e. g., location-based personalized services) are constructed by analyzing key-signals and issues that have impact on the development of ambient media in the future.
- **Forecast for the development of each scenario.** Based on the analyses so far, we have tried to draw a forecast for ambient media in the year 2020 and identify various aspects how the developed scenarios will have an impact in the future. Thus, in this step we have developed a vision for a future media environment. The scenarios have been compared to the workshop results in order to develop ambient media of the year 2020.

The use of this approach was critical for the success of this study. Especially the very wide and hard to graph field of ambient media is difficult to bring under a common umbrella.

1.2 Related work and studies

To conduct this research, we have established a workshop in 2011 on Semantic Ambient Media Experience (SAME) in conjunction with the 5th International Convergence on Communities and Technologies conference in Brisbane, Australia. The following contributions to the workshop acted as starting point for our investigation: [8, 10, 19, 24, 39, 45, 56, 61, 62, 70, 74, 85], and [73] compiled in [48]. However, most of the other key-references are stated within the scope of this article. To mention a few references, we would like to pinpoint to the following for very specific questions to be addressed in ambient media research: user experience and interfaces (see[3, 38], and [40]); ambient assisted living and aging population (see [83] and [68]); general ambient media research (see [44, 47, 48, 49, 50], and[46]); and Artificial Intelligence (AI) (see [60, 71, 75]).

The remainder of this article is organized as follows: Section 2 identifies common denominators of ambient media today. Section 3 presents motivating forces, trends, and signals as indicated by the common denominators. In Section 4, several scenarios for the

investigation how ambient media might develop until the year 2020 are illustrated. Finally, Section 5 is devoted to a discussion and presents our vision for ambient media in 2020.

2 Common denominators of ambient media today

Within the scope of this section several research works are examined to identify common denominators of ambient media today. These are structured according to the fishbone model presented in Fig. 1.

2.1 Technical enabler

The key technical enablers are illustrated in Fig. 2. This section provides a comprehensive overview of their motivation and argues why they are relevant and how they impact ambient media environments. Nevertheless, they can be considered as the main contribution to today's existing ambient media technologies.

2.1.1 Artificial Intelligence (AI)

Smart environments require methods from Artificial Intelligence (AI). AI can be considered as the intelligence of machines and the branch of computer science that aims to create it. AI textbooks define the field as "the study and design of intelligent agents" ([71, 75] and [60]) and an intelligent agent is considered as a system that perceives its environment and takes actions that maximize its chances of success [43]. John McCarthy, who coined the term in

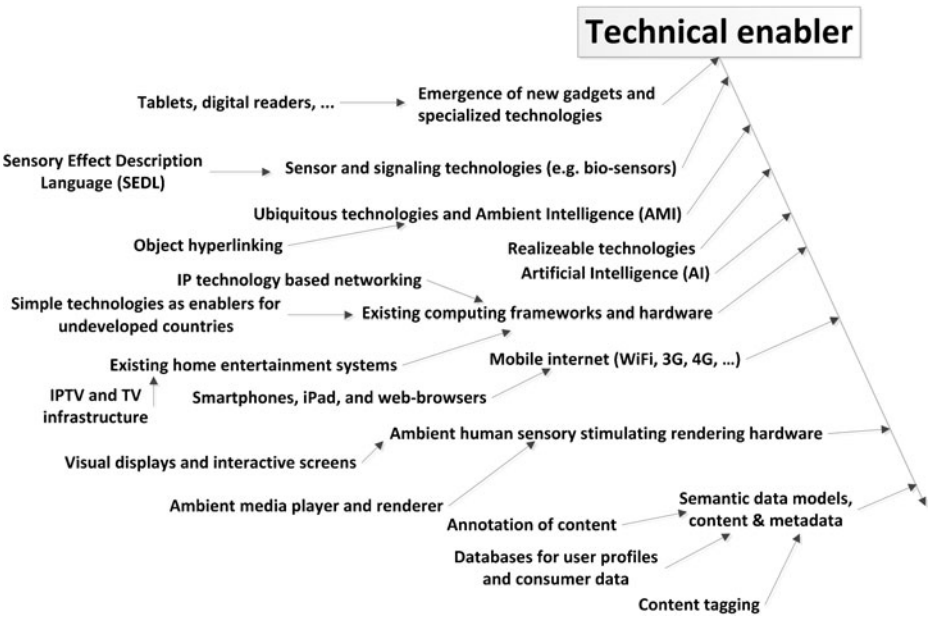

Fig. 2 List of main technical enabler for ambient media today

1955, defines it as "the science and engineering of making intelligent machines" [52]. Thus, any technology that allows smart environments to be even more "intelligent" can be considered as technical enablers for ambient media. Examples for applying AI are systems for health-care monitoring [70]. Semantic ambient media systems for health-care monitoring allow increasing the quality and the safe living of elderly people at their homes. These systems implement AI methods as e. g. automatic classifiers that support autonomous living of elderly people by detecting health problems that are recognizable through movement [70].

2.1.2 Ambient Intelligence (AmI) and ubiquitous technologies

Ambient Intelligence (AmI) refers to electronic environments that are sensitive and responsive to the presence of people. AmI is a vision on the future of consumer electronics, telecommunications, and computing that was originally developed in the late 1990s for the time frame 2010–2020. In an ambient intelligence world devices support people in carrying out their everyday life activities, tasks and rituals in an easy and natural way using information and intelligence that is hidden in the network connecting these devices (see Internet of Things [22]). As these devices become smaller, more connected, and more integrated into our environment the technology disappears into our surroundings until only the user interface remains perceivable. Another aspect of the utilization of ambient intelligence or ubiquitous technologies is the linkage of media objects through physical and digital spaces [19] called "object hyperlinking" which deals with introducing structure to objects. This is demonstrated through various services as demonstrated e. g. by the project Pachube [88]. Therefore, ambient intelligent technologies, ubiquitous computation, and pervasive computation enable a new world of services.

2.1.3 Semantic data models, content, and metadata

Metadata is a set of data that describes and provides information about other data [19]. 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. New types of metadata are starting to permeate every aspect of our daily lives. We have sensor networks in our mobile devices, cars, etc. Being able to get nearly instant access to a large amount of meta-information has added a "sixth sense" of clarity and orientation [19].

This technical view also relates to other methodologies such as the development of ambient content formats and several other aspects relating to the content. Examples for these are technologies for content annotation, content tagging, or databases for content and asset management. The spectrum of technologies range even further: from methods and models for user profiling, personalization to consumer data mining.

2.1.4 Existing computing frameworks, software, and hardware

Currently, there is a lot of technology in form of digital gadgets and home equipment available throughout households. These range from simple mobile phones with basic phone functions, smart phones, Set-Top-Boxes, WebTV platforms, Internet Protocol Television (IPTV), up to high-end home multimedia equipment. One of the most prominent examples

of existing technologies is IP-based networking, which can be seen as the "universal bus system" on the Internet. IP based technologies allow the integration of Internet services and devices, thus, they enable the 'Internet of Things'.

As shown in many research works, also other standard home equipment technologies enable the emergence of new ambient service types as these are traditional equipment that already service as they act as content access points. One example is described in [73], in which a personal health tele-monitoring application is integrated into an IP-TV home environment. The application is implemented as a net-top box application and enables the monitoring of blood pressure and body weight as well as the support for online medical interviews. There are also other systems such as the previously described service for sharing human knowledge via SMS [62]. Therefore, the deployment of existing technologies allows a practical and economical solution for the development of ambient media.

Other aspects of existing computing frameworks, software, and hardware are their robustness, affordability, and availability in developing countries. The mobile social network search based on simple technologies such as SMS is discussed in [62]. The developed concept presented in this work leads to the idea that especially simple technologies are a technical enabler for underdeveloped countries. Due to the high penetration of mobile phones, SMS technology, and cheap prices for an SMS—community networks are suitable to foster mobile social networks in underdeveloped countries. Social networks based on simple technologies such as SMS rather than on Google or other Internet-based services enables a "pricey, short response times, good abandonment, and satisfactory" solution [62]. Thus services based on simple technologies become major technical enablers for underdeveloped countries and provide Internet-alike services to create human-knowledge networks.

2.1.5 Sensor and signaling technologies

Within the scope of this article we will not focus further in depths on this technical enabler, as it has been investigated in other literature already. We solely mention it for completeness. However, we would like to state one explanatory research work to demonstrate potential novelties. Measuring bio-signaling information and the sensory technology to obtain these data signals is an enabling technology that extends existing solutions of sensor and signaling technologies towards the description of human bio-signals. This has been demonstrated in [10] and describes a system that allows the analysis of perceptual quality via EEG bio-signal analysis in multimedia. The system can be utilized, e. g. in multimedia to measure the Quality of Experience (QoE) of consumers enjoying the media content. The whole range of capturing bio-signals can be seen as new field within the ambient media community.

2.1.6 Emergence of new gadgets and specialized technologies

Currently there are a great many new gadgets and specialized technologies emerging on the consumer market. The most prominent examples are tablet PCs, digital book readers, and smartphones. Miniaturized and economical viable availability of this hardware enables the emergence of many new ambient services (e.g. location based services, personalized service offerings). The key is to foster the deployment of new gadgets and consumer electronics.

2.1.7 Ambient human sensory stimulating rendering hardware

Hardware that is stimulating human senses far beyond commonly known audio-visual stimulus.

2.1.8 Mobile internet (e.g. WiFi, 3G, 4G)

Within the scope of this article, we will not focus further in depths on this technical enabler, as it has been investigated in other literature already. We solely mention it for completeness.

2.2 Media characteristics, and consumer experience

The definition of media characteristics and consumer experience requires a multidisciplinary way of thinking. This is especially true in the case of ubiquitous computation, in which the medium as such is embedded into living environments, other aspects coming from architecture, design, communication theory, consumer experience, and media theory. As the most significant difference of ubiquitous media is the space where they flourish, we briefly discuss this aspect. The following denominators where identified and are depicted in Fig. 3.

2.2.1 The daily environment as concept of space

The concept of environmental space became more significant over time. It tends to express the use rate of resources that are unsustainable and inequitable. There is much greater awareness today about environment and considering daily environment as a concept space can progress consumer experience [42]. Also, if quantification of environment space is practiced, the approximation can be sustainably exploded at the universal level.

2.2.2 Social experience as part of urban and daily living environments

A technology enabled social interaction can help to meet psychological needs for different requirements like safety, belonging and love. Technology can enable a wider, faster and frequent interaction which creates the digital social experience. Social involvement has been a significant issue because individuals are tribal and need social connections [66]. Enormous growth of social media is thus tapping the elementary anthropological needs. If encapsulated within the urban and daily living environment, social experience will make a major impact on improving consumer experiences.

2.2.3 Quantified user experience

User experience is made up of four independent elements: branding, usability, functionality and content. Although these are seemingly intangible elements they can be quantified [27]. Quantifying the user experience can serve as a gateway for the business to expand and if priced well the analysis can be a great tool to show new clients about the benefits of the services of quantification of user experience.

2.2.4 Humans embedded inside media environments

The distance between processing of traditional media and processing of ambient media embedded within the media environments might be larger if the media content is human.

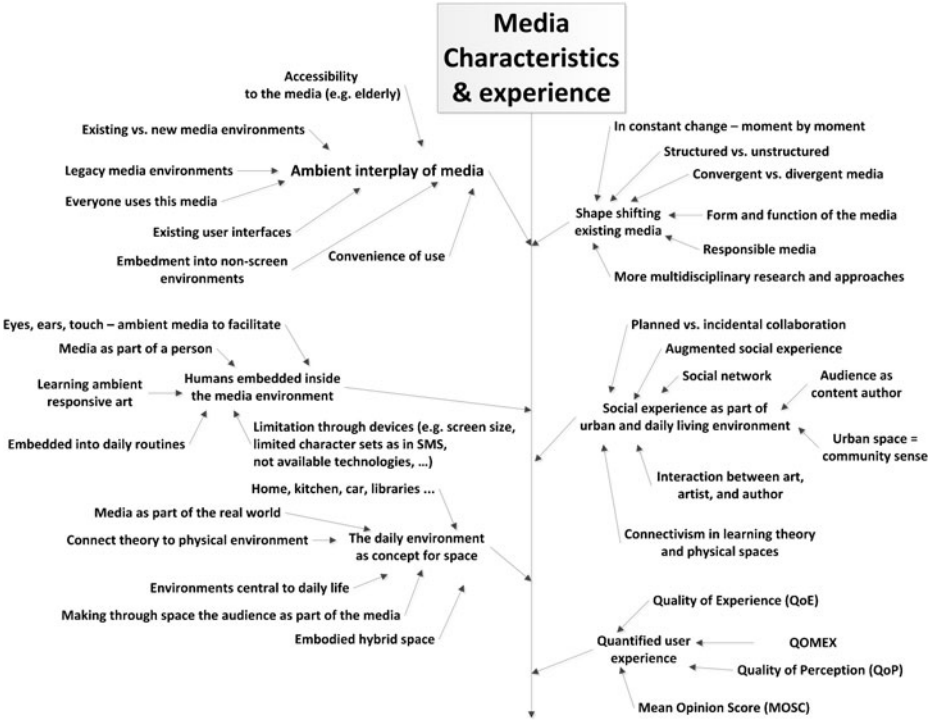

Fig. 3 List of common denominators from the media characteristics, and consumer experience perspective

However, such an environment can offer a mode demanding context for users given that the media environment requires more cognitive resources to be directed towards the task [16].

2.2.5 Shape shifting existing media

The role of new media and social media in shifting the shape of the world is clearly evident today. This shape shifting trope as used in the popular culture like television or internet will lead towards the capability of transformation to completely change one's view about existing media [33].

2.2.6 Ambient interplay of media

Interaction between consumer and brand can improve satisfaction and service. The interplay of ambient media can play a range of services on customer satisfaction measurement and can improve the result over time to make decisions actionable and measureable [63].

2.3 Society, people, HCI, and interaction design

A more complex task was the identification of common denominators of ambient media from a society, people, HCI, and interaction design perspective. The following common denominators have been identified and are presented in Fig. 4.

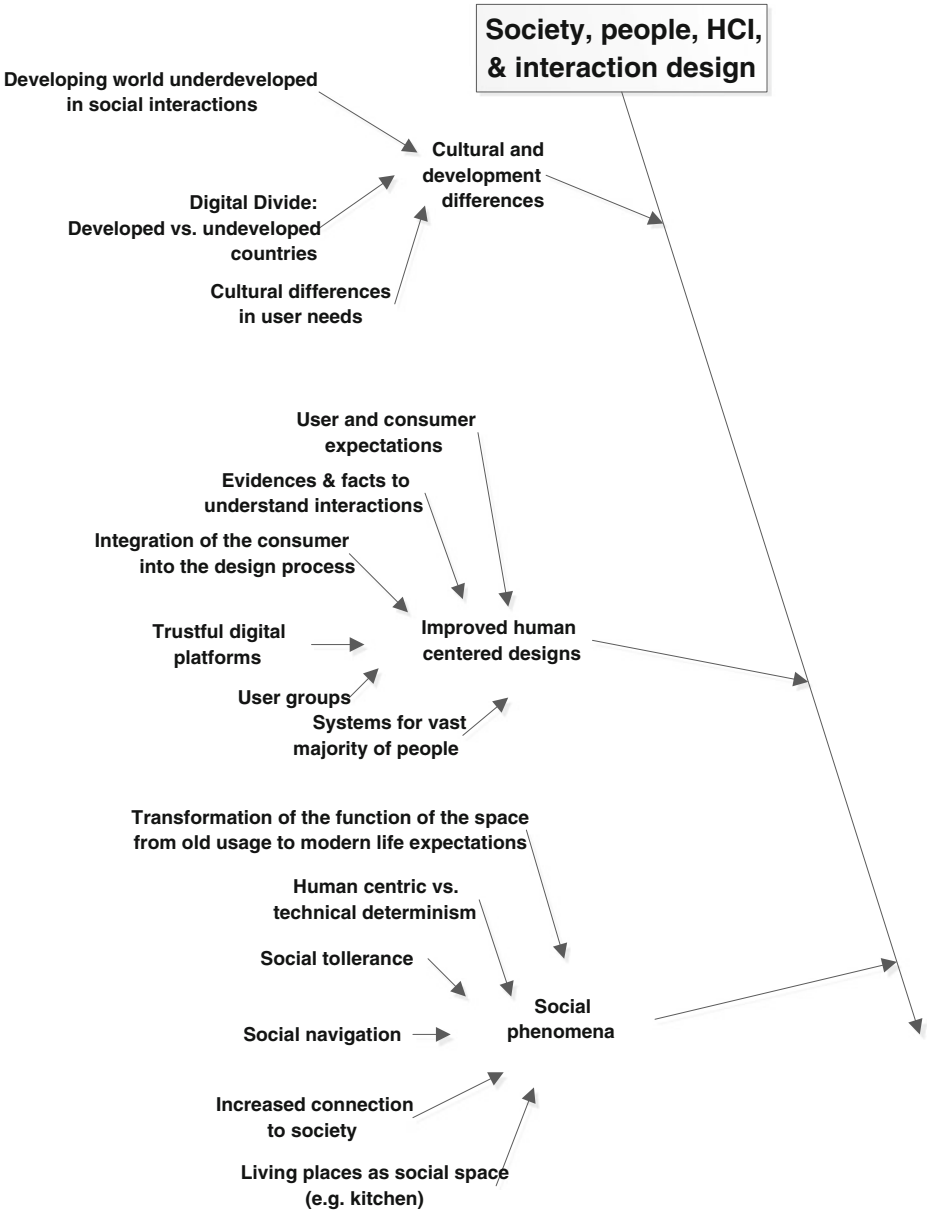

Fig. 4 List of main enabler from the society, HCI, people, and design perspective

2.3.1 Cultural and development differences

The culture of a country can provide certain rules or guidelines to the members of that country for example children and their schooling structure. Different ways of looking at things, different ways of expressing personality are some examples of how differences occur within different cultures. Expansion also occurs differently in different cultures. In some culture time is seen as a limited resource, which is being used up constantly. Alteration between people within any given nation or

culture are definitely bigger than the differences between small groups. As we interrelate with other individuals of different cultures there is no proper substitute for accessibility of interpersonal feedback, good observation skills, and effective questions. Much can be gained by observing how people of the same culture interact with each other and develop over time. See e.g. [6].

2.3.2 Improved human-centered design

Knowing the user of your design has been a key issue of human centered design [41]. We cannot possibly create a better design for people without a deep knowledge of those people. It is thus critical to understand the particular user of a product or service. Since human-centered design has become a dominant theme in design it is automatically being accepted by designers without too much thought. Sometimes it can be risky when things are treated as given. The design can be improved for the focused group at the cost of making the same design worse for others. The fundamental principles of user centered design therefore should be followed and practiced to improve the human centered design, which sometimes can be viewed as activity-centered design too. Thus practicing improved human centered design will improve usability, will lead to less errors during usage, to better learnability and most of all to a higher user satisfaction. For further reading see e.g. [30]

2.3.3 Social phenomena

Social phenomena can include many behaviors that influences or are influenced by humans. For example love is a social phenomenon. HCI, interaction design, people and society are closely related with each other therefore effects of social phenomenon are important in the understanding of ambient media from society's perspective. It is significant to understand the goal of human existence and the future of this present world. Social phenomena like equality, equity, social freedom, efficiency, security are the key examples of parameters that need to be considered in ambient media development and discussion [55]. Subsequently there is no perfect social system in the world and the main purpose of understanding this phenomenon is to improve the everyday lifestyle of humans and different initial state of affairs upon which social phenomena are rooted [55].

As an example to illustrate improved human-centered design we can name the development of technologies that invite for interaction as discussed in [25]. One practical example is determining the optimal navigation speed through content and content presentation [73]. The work focuses on designs and performs an experiment to measure optimal scrolling speed rate for different activities on user interfaces for interactive TV navigation. It has been discovered that the optimal navigation speed depends mainly on the device and wherever simple text or graphics is used in the navigation elements. For instance, with graphics, the optimal speed is 4.8 times slower than with text. Latest architecture of IPTV and interactive TV solutions typically uses fat client approach rather than thin client. These implementations cache the necessary meta-data in the background. Consequently, the user interface can provide fast and responsive user interaction. With this architecture and highly performing hardware, the task of scrolling, which involves a rapid movement through the information space, can cause blurring or disorientation if it occurs too rapidly.

2.4 Methods, techniques, and algorithms

Besides technical enablers, many various methods, techniques, and algorithms are already available from research laboratories. These are shown in Fig. 5, and as common denominator we can identify the following categories.

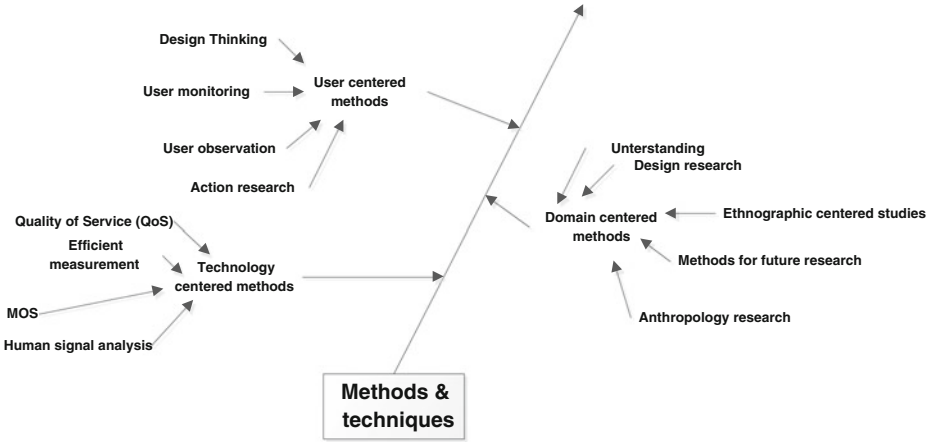

Fig. 5 List of main enabler from the methods & techniques perspective

2.4.1 User-centered methods

These methods are based on user-centered design, which is a type of user interface design and a process in which the needs, wants, and limitations of end users of a product are given extensive attention at each stage of the design process [86]. Such testing is necessary as it is often very difficult for the designers of a product to understand intuitively what a first-time user of their design experiences and what each user's learning curve may look like. The main difference from other product design philosophies is that user-centered design tries to optimize the product around how users can, want, or need to use the product rather than forcing the users to change their behavior to accommodate the product [58].

The paper [21] argues that the difference between user-centered methods and human-centered methods lies in the way in which technology is designed. It concludes that user-centered methods are targeted at the closure of technology-centered problems, and human-centered methods investigate suitable changes to a system of human activity supported by technology. A human-centered design balances systemic inquiry methods with human-centered implementation methods.

2.4.2 Technology-centered methods

These methods consist of the following steps: 1) technology oriented analysis, 2) prototype implementation, 3) usability evaluation, and 4) the revision of design approaches and further prototype development. In the technology-centered methods usability evaluation is used as a way of examining the impact of technology prototypes. The main difference between the technology-centered methods and user-centered methods is that the user-centered approach consists of the following steps: 1) interviews with users, 2) contextual interviews, 3) acting out in context, and 4) design workshop [37].

2.4.3 Domain-centered methods

Domain-centered methods take the domain as the focal point of analysis. As shown in the example of indexing, which has to determine the subject matter of documents and express

the subject matter in index terms, domain centered indexing starts with an analysis of the domain and then moves on to analyze the needs of the users, determines the indexers perspectives and roles, and lastly analyzes the document in the context of the domain and the user's needs. The assumption in the domain-centered approach is that the subject matter and meaning of the documents can be determined only in the context of an understanding of the domain. In other words, a domain and the users' needs frame the meaning and subject matter of documents through the users discourse in the domain [51]. It is, therefore, of utmost importance that indexers understand the domain, the users' roles and interests in the domain, and critically analyze their own roles as indexers before a document is analyzed for its subject matter [51].

As an example for methods and techniques, let us consider ambient assisted living as discussed in [70] and researched within [72]. During the past decade concern for the elderly as well as demographic and economic issues have encouraged research to find assistive technologies for making the lives of elderly people easier and more independent. The aim of the study above is to analyze different approaches and provide ambient assisted-living services to allow the elderly to live safely at home [87] instead of having them to move to nursing homes, which are overcrowded. Moreover, young generations would not be overwhelmed by the need to care of these older adults. The research identifies which of the studied approaches could best provide sustainable elderly care. The targeted health states, activity recognitions and falls detection were suggested by a collaborating medical expert. The following five health states were chosen: normal (healthy), hemiplegia (usually the result of a stroke), Parkinson's disease, pain in the leg and pain in the back.

This study above proposes two approaches for the development of intelligent and ubiquitous care systems that are able to recognize some of the most common and important health problems of the elderly. This recognition is based on the observation and analysis of the characteristics of their movement. The first approach presented in the study uses medically defined attributes and supports vector machine classification into the chosen five health states [69]. The second approach makes a classification of the same five health states using a more general data mining approach.

The movement of the user is captured with an infrared and an inertial motion-capture system. The infrared system consists of tags attached to the body, the coordinates of which are acquired by sensors located in the apartment. The inertial system consists only of inertial sensors attached to the body. The output time series of the coordinates are modeled with the proposed data-mining approaches in order to recognize the specific health problem, activity or fall. In case a health problem or fall is recognized, the remote medical center is notified.

2.5 Content, services, and applications and business value and stakeholders

The more content and service centered perspective led to the following denominators in the context of ambient media. The specific items are illustrated in Figs. 6 and 7.

2.5.1 New possibilities to enrich content and interactivity

The application of new cutting edge technologies like active or passive push pull notification, tagging, emotion detection, and response towards user's mood create new possibilities to enrich the content and interactivity [65]. These technologies allow better designs, better products, and enhance daily life experience with the help of advanced applications and services.

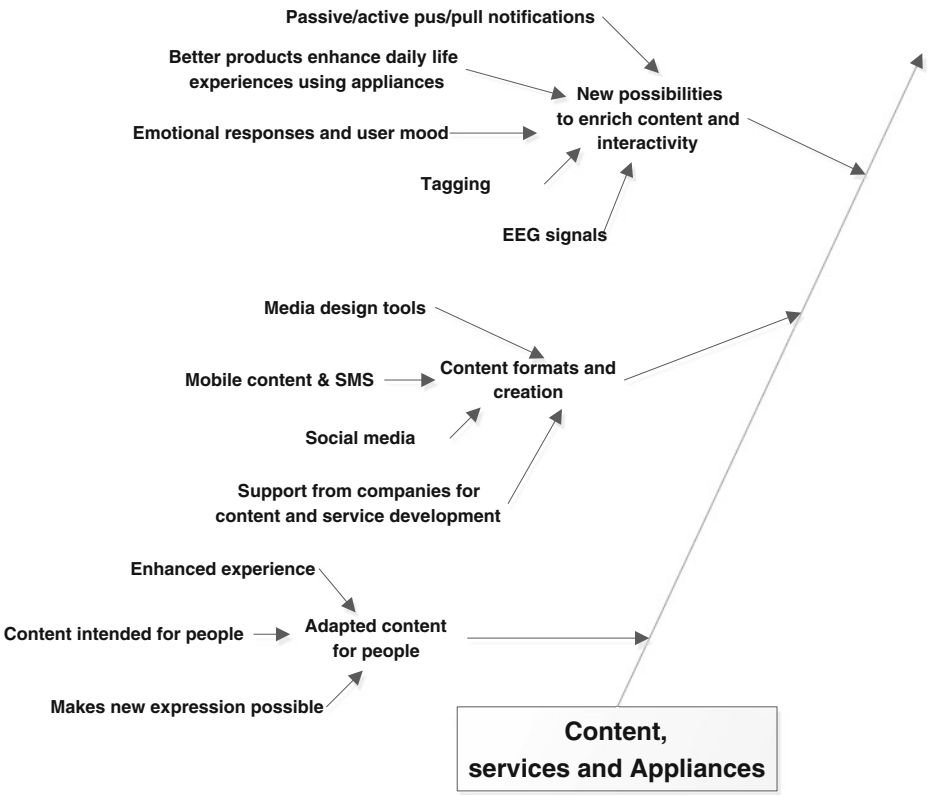

Fig. 6 List of main enabler from the content, services, and appliance perspective

2.5.2 Content formats and new ways of content creation

Mobile content, SMS and social media are already influencing our view on how contents are being shaped and discarded. Mobile design tools and support from companies for content

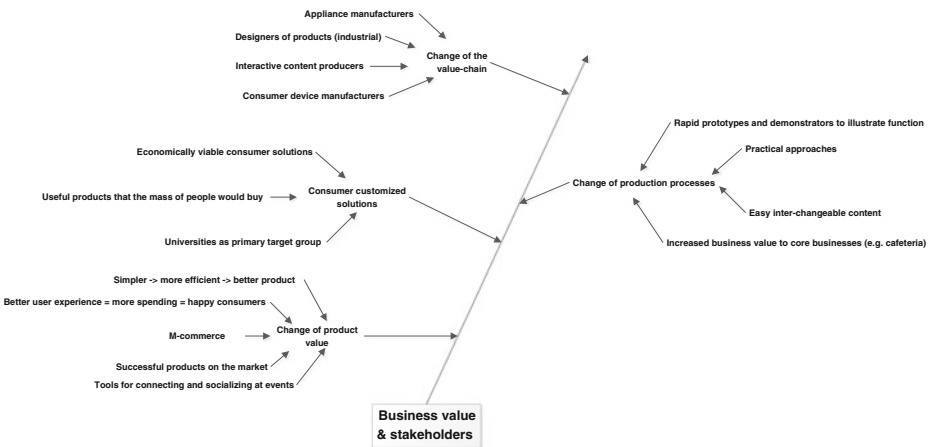

Fig. 7 List of main enabler from the business value & stakeholder perspective

and provision development with the help of social media and mobile content can initiate more novel ways of content creation and different new content formats (see e.g. [15, 31], or [67]).

2.5.3 Adaption of content to people

The use of new content and new possibilities in content creation can enhance user experience. Combined focused content designed for a specific group of people can also increase the experience. New possibilities of expression are thus originated [79]. Adapted content for people can be created with the help of enhanced experience and intended content for people.

2.5.4 Change of the value chain

Business restricting is a complex process and needs different facet of the organization that is involved in the whole process. A completing value chain management process that brings some of the facts together as keys are application manufactures, industrial designers of the product, interactive content producers and consumer product manufactures [35]. With proper arrangement of these keys smoother maneuver and sustainable growth can be attained.

2.5.5 Consumer customized solutions

For many quick consumer testing is critical. Keeping the solution consumer centered is therefore essential [36]. Practicing universal design to create products that the mass would buy and thereby creating economically viable consumer solution can lead towards successful consumer tailored solutions [57].

2.5.6 Change of product value & perception

A simple design is more efficient to use and products having such properties tend to act as improved merchandise in the market. This can create better user experience and users would love to spend more on buying the product [1]. A satisfied customer is the key of creating any change in the value of a product. The use of M-commerce can help enlightening these factors ([1] and [12]). A successful product launch in market and the use of different tools to promote the launch can initiate the perception of the product value and lead towards the creation of a happy client.

2.5.7 Changed production processes

The production process is concerned with transforming a range of inputs into different outputs that are required in the market. However, altering this process is crucial. Change of production process can involve several practical approaches, easy inter-changeable content, rapid exemplar and illustration to demonstrate meanings and increment of business value to core business [54]. However, it is important to keep in mind that the use of different factors can change the production process. However, easy controllability should still be present while the change procedure will take place.

The business value can be best analyzed on the basis of an existing example such as ambient assisted living beyond many others mentioned examples within the scope of this article. The paper of [70] presents the system as an example of the semantic ambient media

for ambient assisted living. The motivation for the paper is the fact that the percentage of elderly people is increasing worldwide and this is particularly so in Europe [69], where the elderly tend to lead an isolated life away from their children. As a result, they may fear not being able to obtain help if they are injured or ill. Projections show that the percentage of the population aged over 65 in the developed countries will rise from 7.5 % in 2009 to 16 % in 2050. In addition, the ratio of the working-age population (between 15 and 64 years) to the population aged over 65 is predicted to decline from 4.3 to 2.3 [84]. Moreover, a study reported in [9] predicts that the cost of funding old-age care paid by the families will more than double in the next 13 years, far outstripping the taxpayers' contributions.

3 Motivating forces, trends, and signals indicated by the common denominators

Within the scope of this section several common denominators were considered to identify trends, forces, and signals how ambient media might be developing in the future.

A few of these trends are described in the following sections and illustrated in Table 1.

Table 1 Motivating forces and trends in the context of ambient media

Motivating forces, trends, and signals implicated by the common denominators
Aging population in developed countries
Need for economic viable services in under developed countries
Safe home living environments for people requiring special attention
Navigation techniques providing fast and easy access to large quantity of information
Decentralized storage of data
Metadata as key for ambient services
Dynamic data as new data model
Decentralized storage of data
Transition from traditional environments to new digital environments
Universal, general designs—services that are designed for all and the vast majority of people
Higher data reliability, frequency, and accuracy
Human centered, adapted, and personalized designs
Convergence of existing technologies, the digital overlay, and physical spaces
Quantification of user experience
More new gadgets and specialized tools involving sensor and signaling technologies
Social experience as part of urban and daily live environments
Shape shifting of existing media environments and spaces towards ambient interplay of media
Cultural development of ambient media in society, across nations, and development levels
Transformation of the notion of space towards modern life expectations in digital environments
Multidisciplinary approaches to design and understand ambient media services
New possibilities to interact, enrich, improve existing or new content formats
Adaptation of the content to people, their experience, and intentions
Change and tighter integration of the business value chain enabling new players
Increased use of bio-logical sensors, human signaling and advanced emotional computation
Economically feasible customized consumer solutions on the mass market
Change of production process through rapid prototyping, simple services, and happy consumers

- **Aging population in developed countries:** There are more and more elderly people in the developed countries and not enough younger people to take care of them. Attempts are made to improve quality and safe living of elderly at their homes [70] as well as to provide elderly users with easy-to-use personal health care systems that are facilitating and extending their independent living in their own private home environments [73].
- **Navigation techniques providing fast and easy access to large quantity of information:** 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 spaces. The goal is the improvement of the usability of horizontal and vertical navigation techniques in modern interactive TV navigation [24].
- **Metadata as key for ambient services:** The future of video and automatic metadata creation will see further increases in automatic identification and labeling like facial recognition, object recognition, and costs comparisons. Video analysis technology will be further integrated with motion capture technologies like the Xbox Kinect that passes criticism on athletic form and on more refined criticisms like body posture and poise for business presentations [19].
- **Dynamic data as new data model:** As said above, metadata is generally speaking data about data [76]. 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 nowadays also scan bar codes on objects in stores, such as food or books as well as augmented reality (AR) quick response (QR) codes. The greatest impact on culture from data and metadata will come from new types of objects that talk to us and to each other generating dynamic metadata. 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 hybridization of physical objects and their access over the Internet. Other very exciting devices that automatically capture metadata for media from the users are the pressure-sensitive keyboard [14] of Microsoft. These keyboards add keystroke-pressure as metadata to the produced text. With the Tone Check service[1] one can check texts such as emails for its underlying emotional tone. It can be used to judge, e.g. if a written text is appropriate to be sent as email. For further reading see e.g. [19].
- **Decentralized storage of data:** Metadata will be more and more created and stored in a decentralized fashion. From 2007 onwards we have been witnessing the emergence of the Linked Open Data (LOD)[2] movement [28], which aims at publishing and interlinking metadata originating from different data sources and being of different quality on the web. Linked Open Data builds open standards such as the Resource Description Framework (RDF) and the eXtensible Markup Language (XML) of the W3C. Since its advent in 2007 LOD has gained widespread popularity and is supported amongst others by the Library of Congress (US), BBC, New York Times. In June 2011 the three largest search engine providers Google, Yahoo! and Microsoft agreed on a common vocabulary called Schema.org[3] for embedded metadata into standard HTML web pages in form of RDF or other Microformats. Linked data is also highly applied to represented

[1] http://tonecheck.com/ (Last accessed: 10/18/2012)
[2] http://linkeddata.org/ (Last accessed: 10/10/2012)
[3] http://schema.org/ (Last accessed: 09/24/2012)

dynamic data provided by sensors and sensing devices reading, e.g. the above mentioned RFID or QR codes. The global sensor network (GSN) is a middleware for processing such dynamic metadata provided by various kinds of sensors in ambient applications and services [34]. One of the first media applications driven by a distributed storage infrastructure is SemaPlorero [78]. It allows the interactive, faceted exploration of a very large amount of semantic, social media data at large scale. The data is of different origin and quality and it is queried in real-time and stored on a distributed storage infrastructure that partially makes use of Amazon Cloud Computing. The overall goal of SemaPlorer was to demonstrate the feasibility of providing efficient interaction with a very large amount of decentralized linked data. It can be expected that the LOD movement will continue and increase tremendously in the near future.

- **Transition from traditional environments to new digital environments:** Internet-enabled Television (IPTV) exposes high potential for bringing individualized health monitoring into the homes of the patients. The technology of IPTV is an excellent example for an ambient media environment of the future. The ease of use and integration into the common environment of the patients has been investigated e. g. in form of an IPTV-based application for measuring the blood pressure and body weight using a regular TV remote control and making it available for online inspection by medical doctors [73]. Taken measures are the weight through a scale and blood pressure monitor connected through a net-top-box. Interviews with the patients through the TV allow the medical doctors to collect information about e. g. the emotional status of the patient. An evaluation with 15 people (three female and twelve male) reach satisfactory results for typical health monitoring tasks like measuring weight, heart rate, answering questions. This issue e.g. is addressed in [73].
- **Universal, general designs—services that are designed for all and the vast majority of people:** The philosophy of information deals with the questions arising from the intersection of the disciplines of computer science, information technology (IT), and the metaphysical questions of philosophy [56]. The goal of universal design is then to provide engineering solutions that will not focus on a specific user group or profession but that develop ambient media systems that are applicable by all [56]. The principles of universal design [81] are that the system's design shall (i) not stigmatize any specific target group (equitable use), (ii) provide a range of different preferences and abilities (flexibility in use), (iii) be easy to understand independent of the user's background (intuitive use), (iv) effectively communicate the information (perceptive information), (v) be robust regarding unintended use (error tolerant), (vi) be efficiently and comfortable in use without minimized fatigue effect (low effort), and be appropriate in its use independent of the user's physical conditions and context (size and space). As concluded by [17, 56, 59], and [18] universal design might be used as potential guidelines for developing games [57] and ambient media applications in general. To this end, the design process for universal design should comprise support for users with disabilities, be carried out by designers that are aware of such disabilities, including end users in the design process right from the beginning, and allow individual adaptation of the developed system [56]. However, universal and more general designs also manifest in other service types such as health care [70]: Instead of proposing a specific approach for detecting a limited set of health problems the paper states that general approaches can be used to classify several types of activities or health problems with high classification accuracies.
- **Higher data reliability, frequency, and accuracy:** With the increase of sensor networks and deployed middleware architectures enabling the processing of sensor data in a more flexible way (see, e. g., [2]), a trend towards a higher amount of real-time data, higher data reliability, frequency, and accuracy is foreseen.

- **Human centered, adapted, and personalized designs:** There is an increase in human-centered services and human-centered content designs that adapt on many levels like interactivity, human being enabled to higher capabilities, and technological capability. One example for this trend is [24], where scrolling speed must be set up taking into account diverse information such as the device on which the system is running, the navigation elements and user experience. This aspect is relevant on many levels such as the evaluation taking user information into account such as demographical data (e. g. the amount of time user evaluation study participants spend on watching TV daily). Also, obtaining statistical analysis from the actual evaluation results can increase the human centered design perspective.

4 Base scenarios for the analysis of ambient media in the year 2020

We developed several scenarios serving as starting point for the investigation how ambient media might develop until 2020. Figure 8 illustrates the relation of several entities previously discussed. It also illustrates the links between technical enablers, media content and services, as well as society, people, consumers, and human-computer interaction. However, the main notion of ambient media is that they are part of the media and living environments. Ambient media can be illustrated as a sub-set of media in spaces as illustrated in Fig. 9.

Scenario 1: ***Ambient Assisted Living (AAL) in daily life***

Examples: Identification of falls, automation or remaining of tasks to do

Short description: The Ambient Assisted Living Joint Program (AAL JP) [72] is a funding activity running from 2008 to 2013 with the aim of enhancing the quality of life of elderly people and strengthening the industrial base in Europe through the use of Information and Communication Technologies (ICT). Therefore, the AAL JP is an activity that operates in the field of services and actions to enable the active ageing among the population, for instance by providing home assistive technologies that help elderly people to identify and treat their illnesses or falls, to automatically buy their medicines, or to automate or remaining them tasks that should be done. The demographic change in Europe, mainly caused by a process of constant and increasing ageing, implies challenges for the states' finances, as it weighs on the pensions' schemes and on the health system, but it also translates into some interesting opportunities for the future. In fact, ageing should be firstly seen as an opportunity to live longer and better after a working lifetime. Secondly, an ageing society presents some interesting advantages on the social level, as older persons are a precious richness in terms of experience, wisdom, and adaptability to societal changes.

Scenario 2: ***Shape shifting existing media***

Examples: IPTV as a base platform, wallpaper screens, personalized street advertisements

Short description: Convergence of existing technologies, services of the digital overlay, and signaling data will shape shifting existing media types. Based on IPTV platforms, the current developments of user interfaces can provide fast and responsive user experience and can be easily integrated into the common environment. The final tendency in shape shifting is to achieve seamless interfaces between humans, digital information, and physical environments. The goal in the next decade will be to change the Graphical User Interfaces (GUIs) from digital physical screens to tangible interfaces on any surface, taking advantage of the richness of multi-modal human senses and skills developed through our lifetime of interaction with the physical world [82]. This will be the base to achieve high advance ambient media applications such as personalized street advertisements using any surface as screen such as building walls, bus stops glass stations, or other augmented reality applications providing dynamic and on-the-fly additional information of products. A prominent example are advertisements in shops where e. g. shopping videos show all the prices based on personalized offers to consumers preferences. Another example is the change of rendering—information is rendered throughout the natural environment via 'non perceptible' media as rendering device. Thus the TV CRT (Cathode Ray Tube) screen in living rooms is replaced by LCD (liquid crystal display)

and in the future eventually will become smart wallpaper screens. A wide range of examples have been contributed to the Nokia Ubimedia MindTrek Award (see [4]). Also, in [53] further examples concerning wearable interaction interfaces via gestures can be found and in [20] examples for advanced monitoring modalities are explained.

Scenario 3: ***New concepts of collaboration, social experience, and social phenomena***

Examples: Multi-person multi-modal interaction, smart collaborative work environments

Short description: Current and coming innovations in ambient technologies will enable interaction between people and information in a myriad of ways, regardless of the used technology or the geographical locations. This will eliminate the technological barriers that exist nowadays, for instance facilitating to share documents or images among different technological devices [7] by just using gestures or wearable interfaces. These new ways of interaction will create new conceptualization of space, collaboration, and social experience. The aim in the future will be to develop new types of human communications, entertainment and working environments that can increase support for remote presence and multi-person multi-modal interaction. In these future interactions real and virtual worlds will be integrated for transmitting not only sound, documents or images but also smells or textures [11]. On the down side, the evolution of technologies for digital social interaction also creates an increasing dependability on social technologies that may cause a decrease in the development of interpersonal skills since users get used to interact using ambient media and not personally.

Scenario 4: ***Ambient media as enablement for user-centered systems***

Examples: Automation of user tasks, user context, smart homes

Short description: Ambient media trigger a transformation towards more human centered designs in which the users do not adapt to the media but the media adapt to the users [77]. Currently, the media is still sometimes intrusive to the users, automating tasks without considering what users really want and what can be really helpful for them. However, the advances of technologies, like context awareness [13] or Internet of Things, are becoming systems more sensitive to users' context, and the devices become smaller and smaller and more and more connected and integrated into our environments. This will enable the vision of Ambient Intelligence and Ubiquitous computing (see Section 2.1.2.) of supporting and facilitating users' tasks in an invisible way. On the other side, the surrounding and support of these ambient media environments will make users change their daily behavior without being aware of it and will steadily, increase the user dependability on technologies. For instance, current smart cars automatically switch on the headlights when needed, so drivers do not have to do this anymore and might forget this when they use a normal car.

Scenario 5: **Smart cities, buildings, and urban environments**

Examples: Ecological and smart city transportation, energy-saving buildings

Short description: Because of the economic and technological changes caused by the globalization and the integration process, cities face the challenge of combining competitiveness and sustainable urban development simultaneously by becoming smart cities [80]. Figure 10 reflects the most important goals to be achieved, such as smart energy and water management, sustainable mobility or improving healthcare systems. Currently, the development of smart cities is based on intelligent infrastructure such as broadband (Fiber To The Home) and smart grids, and other technology innovations such as water harvesting and re-use, solar collection, and energy efficient appliances including heating and cooling. The most important challenges that will be faced in the next decade include: environmental issues such as self-sufficient energy buildings, energy exchanges for renewable energy and e-cars and delivery of e-health, e-education, e-government services as well as digital media and internet services. The final purpose of smart cities is to provoke a change in habits on all levels from the man in the street to our institutions and companies, improving inhabitants' quality of life and building green environments.

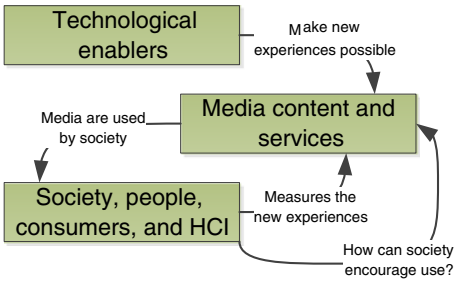

Fig. 8 Relationship between the different categories

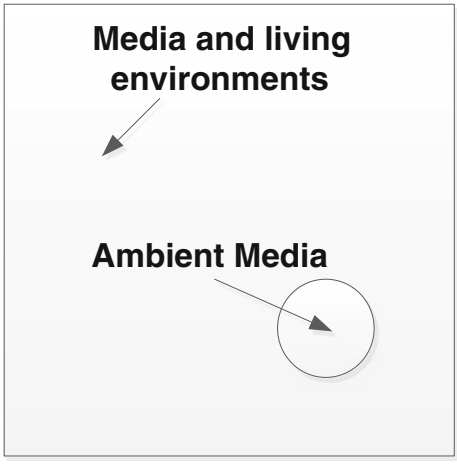

Fig. 9 Ambient Media as part of media and living environments

5 Discussion - a vision for ambient media in the year 2020

Returning to the second question that was stated at the beginning of this article: *How can ambient media develop in the future based on the current state-of-the-art?*. Figure 11 attempts to illustrate the answer to this question.

Do ambient media allow connecting the disconnected? They change the notion of places and breach all physical barriers. They are a medium or window between places as current installations show. An example is interactive screens transmitting video content between two remote places and letting people interact over distance. It is the sense of being at the same place—worldwide, over any distance. This way it is possible to interact with distanced people through ambient media. The experience of ambient media relates to non-physical encounters e. g. via gesture based input. The feeling for being at the same space could even be intensified through the introduction of new technologies such as holography. Also, technology as such is 'transferable' between places. Through an augmentation of tools and bringing social media into the actual physical space further barriers fall that distances people as e.g. location based mobile social media. But connecting distances also relates to building up other barriers such as language differences, exchange and interpretation of gestures, and eventually lets even cultural barriers vanish via technologies such as instant language and gesture translations. Being at the same place also relates to the distance of people located in a similar space. Persons not knowing each other but being at the same physical space (e.g. a library) can get known to each other by services enabling location sharing. It allows to connect people with same interests and to connect to the local community in a fashion of instantly joining and leaving the (virtual) space. Nevertheless, also places will increasingly compete with each other—as they provide digital services as part of the place. A tendency for gamification of the space might lead to another potential direction where ambient might be developing.

Ambient media will enable keeping, sharing, and exchanging knowledge of a place. This relates to the physical and/or digital past of the place and its digital future. In the future, there could be a digital window into the past—either the digital, or the physical past—of the place. Through new technologies such as holography or other media appearances this feeling could be even intensified. Thus, the ambient space becomes an active knowledge sharing alike a living medium. Shorter learnability curves for humans that do not understand the cultural context or its language can be guaranteed through instant translations or interpretations.

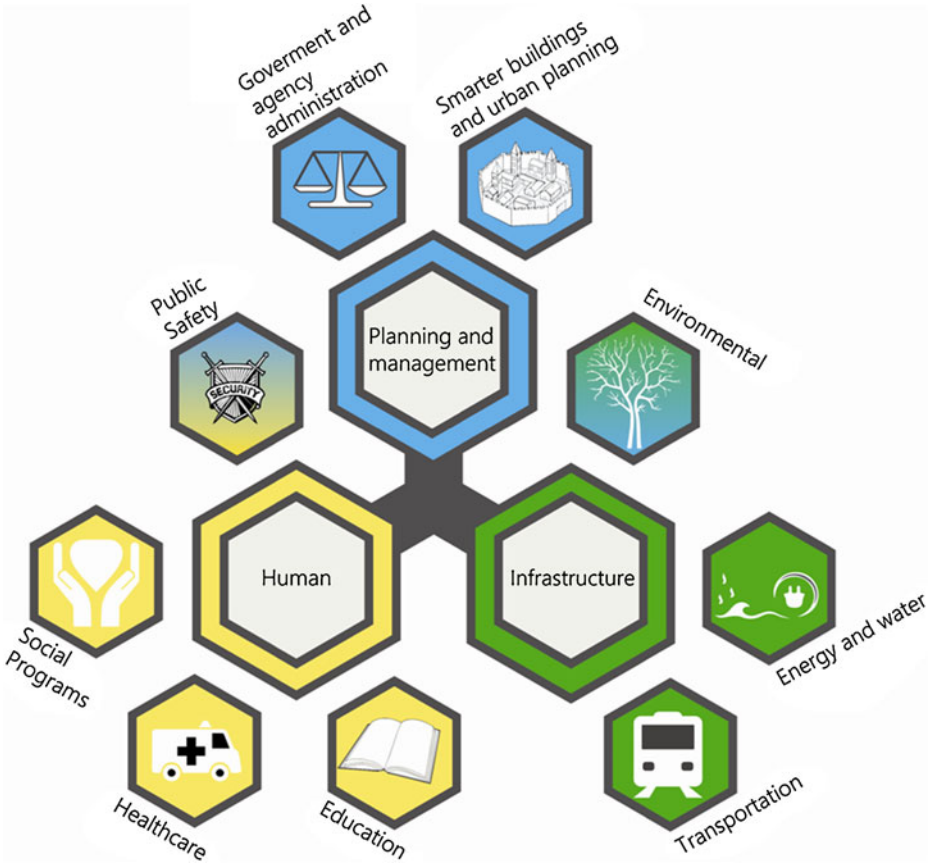

Fig. 10 Smart Cities, Buildings, and Urban Environments (adapted from [32]). Ambient media enable new social phenomena and trigger a transformation of more human centered designs. Smart cities can be identified (and ranked) along six dimensions: smart economy, smart mobility, smart environment, smart people, smart living, and smart governance [26]. These six dimensions are in line with traditional regional and neoclassical theories of urban growth and development. In particular, the dimensions are based, respectively, on theories of regional competitiveness, transport and ICT economics, natural resources, human and social capital, quality of life, and participation of citizens in the governance of cities. Overall, a city is considered as smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic development and a high quality of life, with a wise management of natural resources, through participatory development [23]

The convergence of space, communities, and the digital overlay have many implications. Especially the notion of space is changing in the world of ambient media. A current example is mobile phone applications where people can check-in into places and locations where they currently are. Thus, mobile phones and any future mobile technology will act as technical enabler for personal profile exchange and gathering of sensor information. This also enables more advanced services such as community building by notifying a group of people who actually are in the space. Another example is dating applications as location-based communities. Here the societal impact can be considered as high. But the space with all its digital services becomes alive and actively interacts with the people accommodated in the space—the space notifies who is there and checked into the space. Thus, the digital space allows the

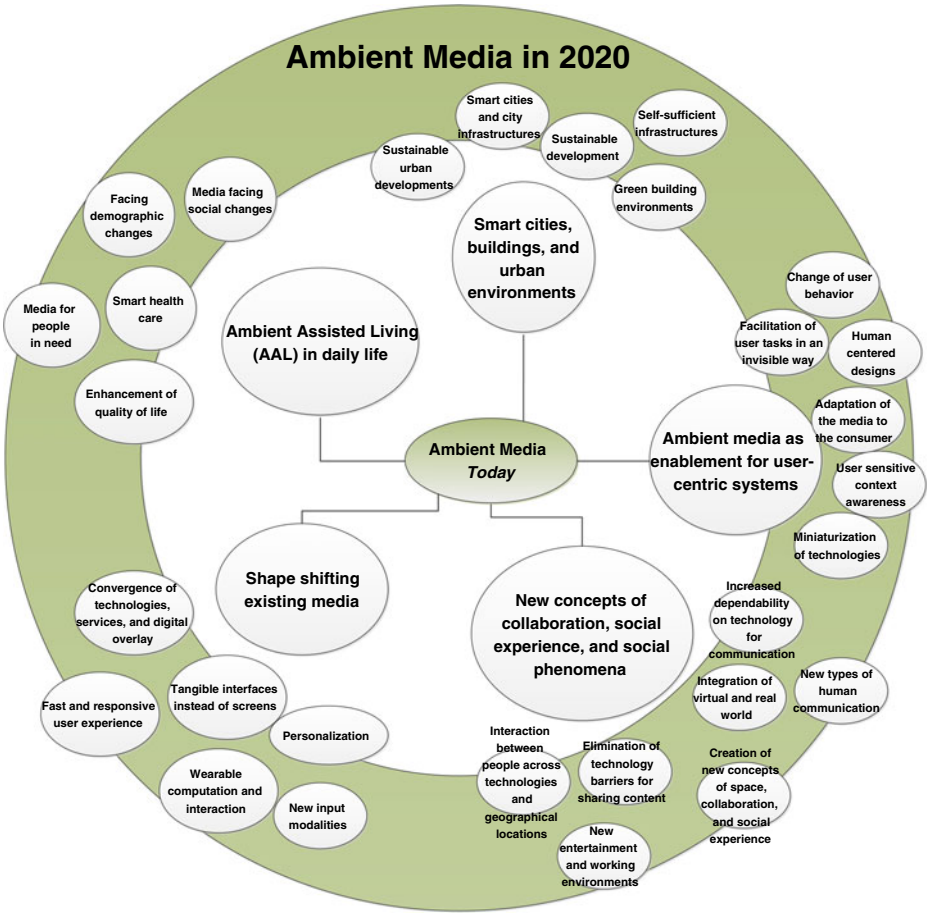

Fig. 11 Future wheel of ambient media services

creation of communities. A simple example is a conference networking tool, enabling attendees to get known to each other. Also the scheduling of events that are taking place at a certain location get eased via ambient media: they allow to schedule these events, inform about opening hours, schedule opening hours, or even provide information about special events such as cocktail hours and offers. Thus, the purpose of the visit of a place is multidimensional. It is not only about the place it is also about its digital services, community building capabilities, and goals. Ambient media assists in achieving the goals that a place can or should provide. The medium merges with the physical architecture and bridges the physical and the temporal space as well.

Human embedded technology—also called biotechnology—in which the role of the human body changes is another factor. The body becomes one with the technology. The depth of the media experience will become more intense via bio-signals. More human embedded technology means also more invasiveness of technology. There are two points of views to this. The first one is on capturing human bio-signals and interpreting these. The second one is on stimulating human senses via novel types of sensors. These possibilities allow triggering new experiences and capturing human signals. The main question is where this development will stop? The social and psychological barriers are high but this discussion

already existed in the past when thinking about other technologies that got introduced e. g. in health care. They were considered as making a human 'inhuman' and taking his soul. But today as e. g. cardiac pacemaker show they are common practice in everyday medical life. This new technology pushes the society forward. One thought is what happens if technology knows more about our mind? What if ambient media know what we are thinking before we are even aware of it? This allows more self-reflection and awareness. Practical examples are sleeping habits and a technology that might allow us to schedule our sleeping better. To further spin the thoughts let us think of what happens with the perception of our non-human living creatures? What if we can feel how plants feel? These new technologies might help to get a better understanding of our nature and create a new awareness of the environment as e. g. plants or animals.

Ambient media also shade a darker future on the possible developments. Ambient media might lead to a cognitive reliance that might increase our dependency on technology and make us functionally dependent on it. Interaction and communication between humans might lead to an increase in mediated interaction, in which where technology replaces the natural interaction and collaboration. We would communicate as we would communicate with robots. Thus ambient media might result in us being disconnected from the real world. Or will ambient media allow us to stay more intensively connected to the real world? This question will be decided in the future.

For sure ambient media will make systems more intelligent. Systems will become more intuitive and enable to overcome barriers that started with the beginning of mankind: different languages, body gestures, and cultural differences. Those differences can be overcome with the use of smart technologies. Ambient technology will lead to a more opened communication and implied structure of language. Thus, so many new possibilities for services and content exist, especially focusing on overcoming cultural, behavioral, and language barriers. Ambient media will lead to a high potential of new services as e. g. ambient news, an advancement of crowd or social media based news services. Under the notion of access to content for everybody content can be created in a reliable way and in a high quality. However, the future will show if there will be free content and information in our everyday life or if business aspects hinder this. At which costs will the content be available? Will social commerce be the price of 'free' content?

As a conclusion let us consider a metaphor. Ambient media are like a seed. Ambient media technologies allow the emergence of many new ideas. Those ideas are the seed to start new ambient projects, services, and applications. Each idea allows us to build a living organism—a tree if we continue this metaphor—that nourishes by community activity. Each human part of the service that connects physical and virtual places can be considered as a branch connected to the trunk of the tree. The leaves are the number of services, connections, and new ideas that have emerged from the one single seed planted. The tree grows through community activity, and flourishes by the social interactions, connections, and ideas. Each new project that gets conducted is a new branch. The tree could grow worldwide, while similar topics are connected to this single idea. All trees and branches have different attributes and characteristics. Instead of water the tree relies on live data to flourish and become older, and older, keeping a long history and track record of its past activities. It is a digital living network of solutions, ideas, and collaboration. To interact with the tree and become a branch, you would need to touch it e. g. via its RFID tags that are represented via leaves. The tree has also colors, representing its relation to the outside word—the seasons. More trees are combined to a forest, in which each tree represents a different project idea and community. This way the trees can interact with each other. Every single tree is a listener and develops its own future within this living environment. The age of the tree and its size represents how the initial idea developed and evolved over the years.

By stating this metaphor, we would like to conclude the discussion how ambient media might be evolving till 2020. We would like to leave it to the reader to think about his/her own vision for ambient media, and solely stimulate the discussion.

Acknowledgments This work was partially financed by the European Union, the European Social Fund. The operation was implemented in the framework of the *Operational Programme for Human Resources Development for the Period 2007–2013, Priority axis 1: Promoting entrepreneurship and adaptability, Main type of activity 1.1.: Experts and researchers for competitive enterprises*.

References

1. (1995) Creating customer value: the path to sustainable competitve advantage. Thomson Executive Press. [Online]. Available: http://books.google.se/books?id=crzhtOiUu4sC
2. Aberer K, Hauswirth M, Salehi A (2006) A middleware for fast and flexible sensor network deployment. Proceedings of the 32nd international conference on Very large data bases. pp 1199–1202. [Online]. Available: http://dl.acm.org/citation.cfm?id=1164243
3. Aladwani AM, Palvia PC (2002) Developing and validating an instrument for measuring user-perceived web quality. Inf. Manage 39(no. 6):467–476, May 2002. [Online]. Available: http://dx.doi.org/10.1016/S0378-7206(01)00113-6
4. Ambient Media Association (AMEA), http://www.ambientmediaassociation.org
5. Andler N (2011) Tools for project management, workshops and consulting: a must-have compendium of essential tools and techniques, 2nd ed. Weinheim: Publicis, by Nicolai Andler.; Originally Published: Erlanger: Publicis, 2008.; Formerly CIP.; Includes bibliographical references
6. Auinger A, Aistleithner A, Kindermann H, Holzinger A (2011) Conformity with user expectations on the web: Are there cultural differences for design principles? Design, User Experience, and Usability. Theory, Methods, Tools and Practice, ser. Lecture Notes in Computer Science, Marcus A (ed). Springer Berlin Heidelberg, vol. 6769, pp 3–12. [Online]. Available: http://dx.doi.org/10.1007/978-3-642-21675-6_1
7. Baldauf M, Lasinger K, Fröhlich P (Jun. 2012) Real-World Drag'n'Drop - Bidirectional Camera-based Media Transfer between Smartphones and Large Displays. In Proc. International Conference on Pervasive Computing, Newcastle, UK
8. Bilandzic M, Jones MG, Foth M (2011) The embodied hybrid space: Designing for digital encounters in physical environments. In: Lugmayr A, Risse T, Stockleben B, Kaario J, Pogorelc B, Asensio ES (eds) 4th Semantic Ambient Media Experience (SAME) Workshop in Conjunction with the 5th International Convergence on Communities and Technologies, Brisbane, Australia: Tampere Univ. of Technology (TUT), June 2011
9. Bingham J (2012) Elderly care costs set to hit 200,000 more pensioners after 'stealth' cut, study suggests. http://www.telegraph.co.uk/health/elderhealth/9179292/Elderly-carecosts-set-to-hit-200000-more-pensioners-after-stealth-cutstudy-suggests.html. The Telegraph. [Online]. Available: http://www.telegraph.co.uk/health/elderhealth/9179292/Elderly-carecosts-set-to-hit-200000-more-pensioners-after-stealth-cutstudy-suggests.html
10. Cheng E, Davis S, Burnett I, Ritz C (2011) An ambient multimedia user experience feedback framework based on user tagging and EEG biosignals. In: Lugmayr A, Risse T, Stockleben B, Kaario J, Pogorelc B, Asensio ES (eds) 4th Semantic Ambient Media Experience (SAME) Workshop in Conjunction with the 5th International Convergence on Communities and Technologies, Brisbane, Australia: Tampere Univ. of Technology (TUT), June 2011
11. Cheok AD (2011) Multi modal sensory human communication in the internet society. 2010 IEEE International Symposium on Mixed and Augmented Reality - Arts, Media, and Humanities, vol. 0, p 1
12. Clarke I (2001) Emerging value propositions for m-commerce. J Bus Strateg 18(2):133–148
13. Dey AK, Abowd GD, Salber D (2001) A conceptual framework and a toolkit for supporting the rapid prototyping of context-aware applications. Hum Comput Interact 16(no. 2, 3 & 4):97–166
14. Dietz PH, Eidelson B, Westhues J, Bathiche S (2009) A practical pressure sensitive computer keyboard. Appl Sci 55–58 [Online]. Available: http://portal.acm.org/citation.cfm?doid=1622176.1622187
15. Dutton W Social Transformation in an Information Society: Rethinking Access to You and the World, ser. Unesco publications for the World summit on the information society. UNESCO, 2004. [Online]. Available: http://books.google.se/books?id=cyEItwAACAAJ
16. Feldmann V (2005) Leveraging Mobile Media: Cross-Media Strategy and Innovation Policy for Mobile Media Communication, ser. Information Age Economy. Physica-Verlag HD. [Online]. Available: http://books.google.se/books?id=OVPH-h0WGwoC
17. Floridi L (2003) Two approaches to the philosophy of information. Mind Mach 13(4):459–469
18. Floridi L (2009) The information society and its philosophy: Introduction to the special issue on the philosophy of information, its nature, and future developments. Inf Soc 25(3):153–158
19. Foster S, Brostoff J (2011) Metadata for the masses: Implications on the pervasive easy availability of metadata in text, video, photography and objects. In: Lugmayr A, Risse T, Stockleben B, Kaario J, Pogorelc B, Asensio ES (eds) 4th Semantic Ambient Media Experience (SAME) Workshop in Conjunction with the 5th International Convergence on Communities and Technologies. Brisbane, Australia: Tampere Univ. of Technology (TUT), June 2011

20. Gangadhar G, Nayak PC (2011) Intelligent refrigerator with monitoring capability through internet. IJCA Special Issue on Wireless Information Networks & Business Information System, no. 2, pp 65–68. Published by Foundation of Computer Science
21. Gasson S (2003) Human-centered vs. user-centered approaches to information system design. J Inf Technol Theory Appl 5:29–46
22. Gershenfeld N, Krikorian R, Cohen D (2004) The internet of things. Sci Am 291(4):76–81
23. Giffinger R, Fertner C, Kramar H, Kalasek R, Pichler-Milanovic N, Meijers E (2007) Smart cities—ranking of european medium-sized cities. http://www.smart-cities.eu/. Vienna: Centre of Regional Science
24. Golja M, Stojmenova E, Humar I (2011) Interactive TV user interface: how fast is too fast? In: Lugmayr A, Risse T, Stockleben B, Kaario J, Pogorelc B, Asensio ES (eds) 4th Semantic Ambient Media Experience (SAME) Workshop in Conjunction with the 5th International Convergence on Communities and Technologies, Brisbane, Australia: Tampere Univ. of Technology (TUT), June 2011
25. HallnÃ¤sL, RedstrÃ¶mJ Slow technology—designing for reflection 5:201–212
26. Hans Schaffers MP, Nicos Komninos (2012) Smart cities as innovation ecosystems sustained by the future internet. FIREBALL White Paper EU's Seventh Framework Programme, p 1, April 2012
27. Hassenzahl M, Diefenbach S, Göritz A (2010) Needs, affect, and interactive products—facets of user experience. Interact Comput 22(no. 5):353–362, Sep 2010. [Online]. Available: http://dx.doi.org/10.1016/j.intcom.2010.04.002
28. Heath T, Bizer C (2011) Linked data: evolving the web into a global data space. In: Hendler J, Van Harmelen F (eds) Morgan & Claypool 1(no. 1). [Online]. Available: http://www.morganclaypool.com/doi/abs/10.2200/S00334ED1V01Y201102WBE001
29. Holzinger A, Kosec P, Schwantzer G, Debevc M, Hofmann-Wellenhof R, Frühauf J (2011) Design and development of a mobile computer application to reengineer workflows in the hospital and the methodology to evaluate its effectiveness. J Biomed Inform 44(no. 6):968–977. [Online]. Available: http://www.sciencedirect.com/science/article/pii/S1532046411001213
30. Holzinger A, Searle G, Wernbacher M (2011) English the effect of previous exposure to technology on acceptance and its importance in usability and accessibility engineering. Eng Univ Access Inf Soc 10:245–260. [Online]. Available: http://dx.doi.org/10.1007/s10209-010-0212-x
31. Holzinger K, Koiner-Erath G, Kosec P, Fassold M, Holzinger A (2012) Archaeoapp rome edition (aare): Making invisible sites visible—e-business aspects of historic knowledge discovery via mobile devices. In: Obaidat MS, Sevillano JL, Zhang Z, Marca DA, van Sinderen M, Marzo J-L, Nicopolitidis P (eds) DCNET/ICE-B/OPTICS. SciTePress pp 115–122. [Online]. Available: http://dblp.uni-trier.de/db/conf/icete/dcnet2012.html#HolzingerKKFH12
32. IBM. Smarter cities. http://www.ibm.com/smarterplanet/us/en/smarter_cities/overview/index.html
33. Jenkins H (2006) Convergence culture: where old and new media collide. New York University Press. [Online]. Available: http://books.google.se/books?id=RlRVNikT06YC
34. Jeung H, Sarni S, Paparrizos I, Sathe S, Aberer K, Dawes N, Papaioannou TG, Lehning M (2010) Effective metadata management in federated sensor networks. pp 107–114. [Online]. Available: http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=5504626
35. Kaplinsky R (2000) A handbook for value chain research. University of Sussex Institure of Development Studies. [Online]. Available: http://books.google.se/books?id=8EcLMQAACAAJ
36. Kelly B, Hughes C, Chapman K, Chun-Yu Louie J, Dixon H, Crawford J, King L, Daube M, Slevin T (2009) Consumer testing of the acceptability and effectiveness of front-of-pack food lab elling systems for the Australian grocery market. Health Promot Int 24:(no. 2)120–129. [Online]. Available: http://dx.doi.org/10.10.1093/heapro/dap012
37. Kjeldskov J, Howard S (2004) Envisioning mobile information services: Combining user- and technology-centered design. In: In Proc. Asia-Pacific Conf. Human-Computer Interaction (APCHI, 2004)
38. Kleinberger T, Becker M, Ras E, Holzinger A, Müller P (2007) Ambient intelligence in assisted living: enable elderly people to handle future interfaces. In Proceedings of the 4th international conference on Universal access in human-computer interaction: ambient interaction, ser. UAHCI'07. Berlin, Heidelberg: Springer-Verlag, pp 103–112. [Online]. Available: http://dl.acm.org/citation.cfm?id=1763296.1763308
39. Kleinen A, Scherp A, Staab S (2011) Coping with the dynamics of open, social media on mobile devices with mobile facets. In: Lugmayr A, Risse T, Stockleben B, Kaario J, Pogorelc B, Asensio ES (eds) 4th Semantic Ambient Media Experience (SAME) Workshop in Conjunction with the 5th International Convergence on Communities and Technologies, Brisbane, Australia: Tampere Univ. of Technology (TUT), June 2011
40. Kuniavsky M (2003) Observing the user experience: A Practitioner's Guide to User Research (Morgan Kaufmann Series in Interactive Technologies) (The Morgan Kaufmann Series in Interactive Technologies). Morgan Kaufmann Publishers Inc., San Francisco
41. Lazar J, Feng J, Hochheiser H (2010) Research methods in human-computer interaction. John Wiley & Sons. Chichester, UK

42. Lee J-H, Hashimoto H (2002) Intelligent space—concept and contents. Adv Robot 16(no. 3):265–280. [Online]. Available: http://dblp.uni-trier.de/db/journals/ar/ar16.html#LeeH02
43. Luger G (2005) Artificial intelligence: Structures and strategies for complex problem solving, ser. Pearson education. Addison-Wesley. [Online]. Available: http://books.google.fi/books?id=QcTuJb7Hi40C
44. Lugmayr A (2012) Connecting the real world with the digital overlay with smart ambient media—applying peirce's categories in the context of ambient media. Multimedia Tools Appl 58:385–398. [Online]. Available: http://dx.doi.org/10.1007/s11042-010-0671-3
45. Lugmayr A, Jalonen M, Zou Y, Libin L, Anzenhofer S (2011) "Design thinking" in media management education—a practical hands-on approach. In: Lugmayr A, Risse T, Stockleben B, Kaario J, Pogorelc B, Asensio ES (eds) 4th Semantic Ambient Media Experience (SAME) Workshop in Conjunction with the 5th International Convergence on Communities and Technologies, Brisbane, Australia: Tampere Univ. of Technology (TUT), June 2011
46. Lugmayr A, Risse T, Stockleben B, Kaario J, Laurila K (2009) Special issue on semantic ambient media experiences. Multimedia Tools Appl 44(no. 3):331–335. [Online]. Available: http://www.springerlink.com/content/w220782h1h508943
47. Lugmayr A, Risse T, Stockleben B, Kaario J, Pogorelc B (eds) (2010) Proceedings of the 3rd Semantic Ambient Media Experience (SAME) Workshop in Conjunction with AmI-10, no. ISBN 978-952-15-2474-5. http://webhotel2.tut.fi.emmi.forum/files/library/201011_SAME_Proceedings_Small.pdf, Tampere Univ. of Technology (TUT), Tampere, Finland, 2010. [Online]. Available: http://webhotel2.tut.fi.emmi.forum/files/library/201011_SAME_Proceedings_Small.pdf
48. Lugmayr A, Risse T, Stockleben B, Kaario J, Pogorelc B, Serral-Asensio E (eds) (2011) Proceedings of the 4th Semantic Ambient Media Experience (SAME) Workshop in Conjunction with the 5th International Converence on Communities and Technologies, no. ISBN 978-952-15-2599-5. Brisbane, Australia: Tampere Univ. of Technology (TUT), Tampere, Finland. [Online]. Available: http://www.ambientmediaassociation.org
49. Lugmayr A, Risse T, Stockleben B, Laurila K, Kaario J (2009) Semantic ambient media—an introduction. Multimedia Tools Appl doi: 10.1007/s11042-009-0282-z [Online]. Available: http://www.springerlink.com/content/5616q82741340375
50. Lugmayr A, Stockleben B, Risse T, Kaario J (2012) Editorial: re-thinking the future of semantic ambient media. Multimedia Tools Appl 58:289–292. [Online]. Available: http://dx.doi.org/10.1007/s11042-011-0899-6
51. Mai J-E (2005) Analysis in indexing: document and domain centered approaches. Inf Process Manage 41 (no. 3):599–611, May 2005. [Online]. Available: http://dx.doi.org/10.1016/j.ipm.2003.12.004
52. McCarthy J What is AI? http://www-formal.stanford.edu/jmc/whatisai/whatisai.html. [Online]. Available: http://www-formal.stanford.edu/jmc/whatisai/whatisai.html
53. Mistry P, Maes P (2009) Sixthsense: A wearable gestural interface. In ACM SIGGRAPH ASIA 2009 Sketches, ser. SIGGRAPH ASIA'09. New York, NY, USA: ACM, pp. 11:1–11:1. [Online]. Available: http://doi.acm.org/10.1145/1667146.1667160
54. Morroni M (2009) Production process and technical change. Cambridge University Press, New York [Online]. Available: http://books.google.se/books?id=2ggzi83LvkEC
55. Moscovici S (1991) The invention of society: Psychological explanations for social phenomena. Wiley. [Online]. Available: http://books.google.se/books?id=JHWPeSzHmNMC
56. Mustaquim M (2011) Philosophy of universal game design. In: Lugmayr A, Risse T, Stockleben B, Kaario J, Pogorelc B, Asensio ES (eds) 4th Semantic Ambient Media Experience (SAME) Workshop in Conjunction with the 5th International Convergence on Communities and Technologies, Brisbane, Australia: Tampere Univ. of Technology (TUT), June 2011
57. Mustaquim MM (2012) Assessment of universal design principles for analyzing computer games' accessibility. In Proceedings of the 13th international conference on Computers Helping People with Special Needs - Volume Part I, ser. ICCHP'12. Springer-Verlag, Berlin, Heidelberg, pp 428–435. [Online]. Available: http://dx.doi.org/10.1007/978-3-642-31522-0_65
58. Napper V (1991) English Design at work: Cooperative design of computer systems. In: Greenbaum J, Kyng M (eds) The book, design at work: Cooperative design of computer systems, lawrence erlbaum associates, 1991, (isbn 0-8058-611-3) is available in hardback (49.95) *and paperback* (29.95), EnglishEducational Technology Research and Development, vol. 42, pp. 97–99, 1994. [Online]. Available: http://dx.doi.org/10.1007/BF02298175
59. NC State University, Raleigh, NC, USA (2010) The principles of universal design: Version 2.0 (tr), Center for Universal Design, NC State University, Tech. Rep. [Online]. Available: http://www.ncsu.edu/project/design-projects/udi/publications/cud-info/principles-of-universal-design/
60. Nilsson N (1998) Artificial intelligence: A new synthesis. Morgan Kaufmann Publishers. San Francisco, CA
61. Obal D, Stojmenova E (2011) Experience to understand: Designing for kitchen interactions. In: Lugmayr A, Risse T, Stockleben B, Kaario J, Pogorelc B, Asensio ES (eds) 4th Semantic Ambient Media

Experience (SAME) Workshop in Conjunction with the 5th International Convergence on Communities and Technologies, Brisbane, Australia: Tampere Univ. of Technology (TUT), June 2011
62. Oh J-S (2011) Either google or your friends, which of them do you believe? mobile social networking search. In: Lugmayr A, Risse T, Stockleben B, Kaario J, Pogorelc B, Asensio ES (eds) 4th Semantic Ambient Media Experience (SAME) Workshop in Conjunction with the 5th International Convergence on Communities and Technologies, Brisbane, Australia: Tampere Univ. of Technology (TUT), June 2011
63. Oliver R (2010) Satisfaction: A behavioral perspective on the consumer. M.E. Sharpe. [Online]. Available: http://www.google.se/books?id=IJ5846z99tIC
64. Ollikainen V, Aalto E, Kivelä J, Kuula T, Liinasuo M, Lindqvist U, Lugmayr A, Maho H, Norros L, Seisto A, Zheng H (2012) New electronic media (NELME) - 2016 foresight. http://www.vtt.fi/inf/pdf/technology/2012/T31.pdf. VTT Technical Research Center of Finland
65. Olsson T (2009) Creating, managing and sharing memories with mobile phones: A user-centred design approach. [Online]. Available: http://dspace.cc.tut.fi/dpub/handle/123456789/6099
66. Pacione M (2003) Urban environmental quality and human well-being: a social geographical perspective. Landsc Urban Plan 65(1–2):19–30
67. Peischl B, Ziefle M, Holzinger A (2012) A mobile information system for improved navigation in public transport—user centered design, development, evaluation and e-business scenarios of a mobile roadmap application. In: Obaidat MS, Sevillano JL, Zhang Z, Marca DA, van Sinderen M, Marzo J-L, Nicopolitidis P (eds) DCNET/ICE-B/OPTICS. SciTePress, pp 217–221. [Online]. Available: http://dblp.uni-trier.de/db/conf/icete/dcnet2012.html#PeischlZH12
68. Pogorelc B, Bosnic Z, Gams M (2012) Automatic recognition of gait-related health problems in the elderly using machine learning. Multimedia Tools Appl 58:333–354 doi: 10.1007/s11042-011-0786-1. [Online]. Available: http://dx.doi.org/10.1007/s11042-011-0786-1
69. Pogorelc B, Gams M (2010) Medically driven data mining application: Recognition of health problems from gait patterns of elderly. In IEEE International Conference on Data Mining. pp 976–980
70. Pogorelc B, Gams M (2011) Comparison of two ambient intelligence approaches to elderly care. In: Lugmayr A, Risse T, Stockleben B, Kaario J, Pogorelc B, Asensio ES (eds) 4th Semantic Ambient Media Experience (SAME) Workshop in Conjunction with the 5th International Convergence on Communities and Technologies, Brisbane, Australia: Tampere Univ. of Technology (TUT), June 2011
71. Poole D, Mackworth A, Goebel R (1998) Computational Intelligence: A logical approach. Oxford University Press, Oxford [Online]. Available: http://books.google.fi/books?id=3p6KZSHjD4YC
72. A. A. L. J. Programme (2012) http://www.aal-europe.eu/
73. Pustisek M, Zebec L, Stojmenova E, Kervina D (2011) Bringing health telemonitoring into IPTV based AMI environments. In: Lugmayr A, Risse T, Stockleben B, Kaario J, Pogorelc B, Asensio ES (eds) 4th Semantic Ambient Media Experience (SAME) Workshop in Conjunction with the 5th International Convergence on Communities and Technologies, Brisbane, Australia: Tampere Univ. of Technology (TUT), June 2011
74. Rahman ASMM, Saddik AE (2011) Virtual rendering based on second life mobile application to control ambient media services. In: Lugmayr A, Risse T, Stockleben B, Kaario J, Pogorelc B, Asensio ES (eds) 4th Semantic Ambient Media Experience (SAME) Workshop in Conjunction with the 5th International Convergence on Communities and Technologies, Brisbane, Australia: Tampere Univ. of Technology (TUT), June 2011
75. Russell J, Cohn R (2012) A.I. Artificial Intelligence. Book on Demand, 2012. [Online]. Available: http://books.google.fi/books?id=E2tOMQEACAAJ
76. Saathoff C, Scherp A (2010) Unlocking the semantics of multimedia presentations in the web with the multimedia metadata ontology. Proceedings of the 19th international conference on World wide web WWW 10, no. 19/2009, p 831. [Online]. Available: http://portal.acm.org/citation.cfm?doid=1772690.1772775
77. Salvendy G (2005) Handbook of human factors and ergonomics. John Wiley & Sons, Inc., New York
78. Schenk S, Saathoff C, Staab S, Scherp A (2009) Semaplorer—interactive semantic exploration of data and media based on a federated cloud infrastructure. Web Semant Sci Serv Agents World Wide Web 7(no. 4):298–304. [Online]. Available: http://linkinghub.elsevier.com/retrieve/pii/S1570826809000481
79. Scott P, Gibbons M, Nowotny H, Limoges C, Trow M, Schwartzman S (1994) The new production of knowledge: The Dynamics of Science and Research in Contemporary Societies, ser. The new production of knowledge: The dynamics of science and research in contemporary societies. SAGE Publications. [Online]. Available: http://books.google.se/books?id=KS_caFqMFoMC
80. Smart Cities. http://www.smart-cities.eu/
81. Story MF (1998) Maximizing usability: the principles of universal design. Assist Technol 10(1):4–12
82. Tangible Media http://www.media.mit.edu/research/groups/tangible-media
83. Toyne S (2002) Ageing: Europe's growing problem (bbc news). http://news.bbc.co.uk/2/hi/business/2248531.stm. BBC News. [Online]. Available: http://news.bbc.co.uk/2/hi/business/2248531.stm
84. United Nations (2009) World population ageing, Report, 2009

85. VasovicA (2011) Crucially important disposition of flourescent pink rose petals in space. In: Lugmayr A, Risse T, Stockleben B, Kaario J, Pogorelc B, Asensio ES (eds) 4th Semantic Ambient Media Experience (SAME) Workshop in Conjunction with the 5th International Convergence on Communities and Technologies, Brisbane, Australia: Tampere Univ. of Technology (TUT), June .
86. Vredenburg K, Mao J-Y, Smith PW, Carey T (2002) A survey of user-centered design practice. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, ser. CHI'02. New York, NY, USA: ACM pp 471–478. [Online]. Available: http://doi.acm.org/10.1145/503376.503460
87. Wild K, Boise L (2012) In-home monitoring technologies: Perspectives and priorities of older adults. In: Handbook of Ambient Assisted Living, pp 94–111
88. Zhang X, Wen Z, Wu Y, Zou J (2011) The implementation and application of the internet of things platform based on the rest architecture. In: Business Management and Electronic Information (BMEI), 2011 International Conference on, vol. 2, May 2011, pp 43–45

Prof. Dr. Artur Lugmayr describes himself as a creative thinker of future media environemtns, and his scientific work is situated between art and science. He has over 15 years experience in the wider field of digital media from a business, technological, and content creation perspective. His experience extends towards digital television, digital film making, virtual reality, media business information management, business consultancy, social media, ambient media, and creative media designs. His vision is to *create innovative media experiences with emerging media platforms tagged with solid buisness models and processes.* Starting from July 2009 he is full-professor for entertainment and media production management at the *Department of Business Information Management and Logistics* at the *Tampere University of Technology (TUT)* and founded the *EMMi - Entertainment and Media Production Management Lab*. He was the head and founder of the *New AMbient MUltimedia (NAMU)* research group at the Tampere University of Technology (TUT), Finland, which was part of the Finnish Academy Centre of Excellence of Signal Processing from 2006 to 2011. He is holding a Dr.-Techn. degree from the Tampere University of Technology (TUT), Finland, and is currently engaged in Dr.-Arts studies at the School of Motion Pictures, TV and Production Design (Aalto Univ.), Helsinki, Finland. He managed and coordinated numerous large scale scientific projects on national and international level; was guest scientist at several universities and/or hold guest lectures/talks (e.g. Harvard Medical School/USA, QUT/Australia, KTH/Sweden, UFAM/Brasil, Univ. of Neuchatel/Switzerland); chaired the ISO/IEC ad-hoc group "MPEG-21 in broadcasting'; won the NOKIA Award of 2003 with the text book "Digital interactive TV and Metadata' published by Springer-Verlag in 2004; representative of the Swan Lake Moving Image & Music Award; board member of MindTrek Association; EU project proposal reviewer; invited key-note speaker for several conferences; founder of the Ambient Media Association (AMEA); supervised over 30 thesis works; general chair of several conferences (e.g. EuroITV, Academic MindTrek); organized over 20 workshops (e.g. SAME workshop series); established several competition situated between art and technology (e.g. Nokia Ubimedia MindTrek Award, EuroITV Grand Challenge); held over 10 scientific conference tutorials (e.g. ICME, EuroITV, uxTV, ACM Multimedia); is editorial board member of several journals and publishers (e.g. Springer-Verlag, SERSC Press, IGI, ACM Computers in Entertainment); acted as review/programme committee member of over 30 conferences; contributed numerous books, book chapters, and wrote over 50 scientific publications. He founded the production company LugYmedia Inc. and is in the process to establish new startup companies.

Estefanía Serral is a postdoc researcher and lecturer in the Christian Doppler Laboratory "Software Engineering Integration for Flexible Automation Systems" at Technical University of Vienna (TUW). Her research and teaching in the CDL-Flex is focused on the area of "Semantic Integration". She received her master and PhD degrees in computer science at the Universitat Politècnica de València (UPV) where was working as a senior researcher in the PROS Research Center until 2012. Her main research areas are conceptual modeling, model-driven development (MDD), ambient intelligence, context-awareness, model evolution, task automation and semantic web technologies. She has published several contributions to well-known international conferences and scientific journals such as CAiSE, MOBIQUITOUS, ER, ERCIM, The Computer Journal, etc.

Ansgar Scherp is Juniorprofessor for Media Informatics and New Media in Business Informatics at the Research Group on Data and Web Science of the University of Mannheim since August 2012. Prior to that he was working as Juniorprofessor for Semantic Web at the University of Koblenz-Landau in the Institute for Information Systems Research since April 2011 and lead the focus group on Interactive and Multimedia Web at the Institute for Web Science and Technologies (WeST) at the same university since May 2008. He has studied computer science at the University of Oldenburg, Germany and has received the Advancement Award for Outstanding Results in Studies from the Association for Electrical, Electronic & Information Technologies (VDE), Germany in 1998. He finished his PhD with the thesis title "A Component Framework for Personalized Multimedia Applications" at the University of Oldenburg, Germany with distinction in 2006. Afterwards, Mr. Scherp has been EU Marie Curie Fellow with Prof. Ramesh Jain at the Donald Bren School of Information and Computer Sciences, University of California, Irvine, USA in Los Angeles between November 2006 to October 2007. In December 2011, he has received his Venia Legendi (Habilitation) with the thesis title "Semantic Media Management: Process Innovation along the Value Chain of Media Companies" (in German) from the University of Koblenz-Landau, Germany. He has published over 60 peer-reviewed scientific publications including 12 journal articles, 21 conference papers, and 10 book chapters.

Bogdan Pogorelc (http://dis.ijs.si/bogdan/) is a Ph.D. candidate and a Research Assistant at Department of Intelligent Systems at Jožef Stefan Institute (JSI) in Ljubljana, Slovenia. Since 2008 he has been employed at Jožef Stefan Institute and Špica International d.o.o. for which he obtained the Young Researcher fellowship. Bogdan was visiting researcher at University Rovira i Virgili in Tarragona (Spain) in 2007, where he performed research on Fuzzy Artmap neural network for assessment of metabolic syndrome. He received several awards for his research: e.g., 1 Prize at Slovenian forum of innovations for Intelligent security system for the surveillance of buildings in 2009 and awards of 1) National Instruments and 2) University of Maribor for Mobile electrocardiograph in 2006. His publication list consists of more than 50 items, 8 of them in scientific journals. He is a reviewer for several scientific journals and conferences, a member of several scientific societies, e.g., ACM, IEEE and ECCAI, and a Program committee- and Organizational committee member of the series of Jožef Stefan International Postgraduate School Student's Conferences and of the series of International Workshops on Semantic Ambient Media Experience. His work Intelligent surveillance system and procedure for detecting unusual activities is in the patent pending procedure. Bogdan's research interests include artificial intelligence, machine learning, (temporal-/time series-) data mining as well as applications in these areas, especially medical informatics and ambient intelligence. His main research interests are health problem recognition, activity recognition and fall detection.

Moyen Mustaquim is a doctoral researcher and lecturer in the Human-Computer Interaction division of Department of Informatics and Media, Uppsala University, Sweden. He also works independently as a consultant for system design and education. Moyen's research interests are understanding universal design and its possibility within and beyond the scope of accessibility. His research interests focuses on video games, social media, multimodality, internet and new media, universal design and inclusive design. Moyen has his Bachelors in Computer Science and Engineering from his home country Bangladesh. And he studied Masters in Scientific Computing and Human-Computer Interaction at Uppsala University, Sweden.