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Ambient bloom: new business, content, design and models to increase the semantic ambient media experience

Bogdan Pogorelc · Artur Lugmayr · Björn Stockleben · Radu-Daniel Vatavu · Nina Tahmasebi · Estefanía Serral · Emilija Stojmenova · Bojan Imperl · Thomas Risse · Gideon Zenz · Matjaž Gams

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Abstract *Semantic ambient media* are the novel trend in the world of media reaching from the pioneering subareas such as ambient advertising to the new and emerging subareas such as *ambient assisted living*. They will likely shape the upcoming years in terms of modeling smart environments and also media consumption and interaction. This work analyzes semantic ambient media by considering business models, content and media, interaction

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

M. Gams
e-mail: matjaz.gams@ijs.si

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

B. Pogorelc · M. Gams
Jozef Stefan International Postgraduate School, Jamova 39, 1000 Ljubljana, Slovenia

A. Lugmayr
EMMi Lab., Tampere University of Technology (TUT), Tampere, Finland
e-mail: artur.lugmayr@tut.fi

B. Stockleben
University of Applied Sciences Magdeburg-Stendal, Magdeburg, Germany
e-mail: bjoern.stockleben@hs-magdeburg.de

R.-D. Vatavu
University "Stefan cel Mare" of Suceava, Suceava, Romania
e-mail: vatavu@eed.usv.ro

N. Tahmasebi · T. Risse · G. Zenz
L3S Research Center, Hanover, Germany

N. Tahmasebi
e-mail: tahmasebi@l3s.de

T. Risse
e-mail: risse@l3s.de

G. Zenz
e-mail: zenz@l3s.de

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design and consumer experience, and methods and techniques that are important to create this new form of media. Discussion is led using the state-of-the-art event of the semantic ambient media, which is the annual international workshop on Semantic Ambient Media Experience (SAME). The study also creates a vision for how ambient media will evolve and how they will look like in the future decade.

Keywords Semantic ambient media · Experience · Business · Ambient assisted living · Ambient content · Business models · Consumer experiences · Interaction design

1 Introduction

Semantic ambient media are the novel trend in the world of media reaching from the pioneering subareas such as ambient advertising to the new and emerging subareas such as *ambient assisted living (AAL)*. They are undergoing a remarkable change and many new research aspects are being continuously contributed to the area. Therefore, it is important to understand and gain knowledge on potential business models, how the media as such are transforming, how interaction design and experience can be modeled, and what models, concepts, and frameworks exist that support the investigation in the field of ambient media.

The paper is discussing the results and the findings of the Semantic Ambient Media Experience workshop focused on four aspects:

- **Content and media:** Content is what is transmitting through the media. Until recently, content was identified as single entities to information—a video stream, audio stream, TV broadcast, etc. However, in the age of ambient media, the notion of content extends from the single entity thinking towards a plethora of sensor networks, smart devices, personalized services, and media embedded in the natural environment of the user.
- **Business:** A media business is the value provided by the media and it has two products for selling: its content (to readers and viewers); and its audience (to advertisers).
- **Interactive design and experience:** Ambient media have a social interactive nature that must guide their design and experience.
- **Models, methods, concepts and frameworks:** They are designed and built for ambient media.

Within the scope of this paper, we present a current state of the art of the area and a forecast of semantic ambient media for the future.

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

E. Stojmenova · B. Imperl
Iskratel, d.o.o., Kranj, Slovenia

E. Stojmenova
e-mail: stojmenova@iskratel.si

B. Imperl
e-mail: bojan.imperl@uni-mb.si

The paper is organized as follows. Section 2 presents Semantic Ambient Media field. In Section 3, the four-leave flower concept is described, which was created in order to encourage focused discussions as well as to offer a broad overview of semantic ambient media span and implications. Within the Section 3, the idea behind the flower concept is introduced and method of the implementation in the SAME workshop is thoroughly described. The rest of the subsections present the contributions to the field, grouped into three thematic groups. Section 4 envisions the future of the Semantic Ambient Media, grouped into five thematic areas: 1) Explicit vs. implicit communication, 2) Textiles as communication medium and embodiment of the individual, 3) Privacy and social implications of ambient media, 4) Improvement of the quality of ambient-assisted living and 5) Context awareness and smart monitoring. Section 5 summarizes the flower concept and Section 6 concludes the paper.

2 Semantic ambient media

Ambient media originated in media jargon more than two decades ago and later became standard term of ambient advertising [4]. In a broader sense, the ambient media define the media environment and the communication of information in ubiquitous and pervasive environments (e.g., between the environment and people through reasoning from sensors, and through the interaction between people and machines) [21]. With addition of intelligence, sensory data are tranformed into valuable context information and combined in a new type of media: *semantic ambient media*.

A novel research area of semantic ambient media is *ambient-assisted living (AAL)* [1, 28], significantly supported by the European Union. Its goal is to enhance the quality of life of the elderly and release the burden on the supporting population. The motivation of the new funding activity is related to demographic changes, in particular the aging of the European population, which implies not only challenges, but also opportunities for the citizens, the social and healthcare systems as well as industry and the European market.

Due to evolving nature of semantic ambient media and media in general, a novel research area of semantic ambient media has been introduced. This is *health-monitoring media* [36]. According to Wikipedia, “media are the storage and transmission channels or tools used to store and deliver information or data. Their goal is to communicate any data for any purpose”. In line with this definition, a health-monitoring medium is a transmission tool used to deliver information (content) from a physical world to a digital world. It uses sensors to capture data from the environment (e.g., body movement, physiological signals, sound or temperature). Then, the machine learning [11] is used, e.g., to recognize health problems or activities of elderly, which is an information delivered to a digital world. This information can be transmitted back to a physical world through representation of the information to a user, e.g., explanation of a patient's diagnosis to a medical expert [6, 33, 35].

Important research area of semantic ambient media is a *language evolution*. When presenting language evolution there are resources that need to be shown over a time line. In [7] there are pointers on how to visualize resources over a time line as well as in clock visualization and allow interactions. In the paper video resources are shown but the work can also be applied to text. To make the data presentable for the

younger generations as well one could consider using pointers from [10] where a system is presented that helps children learn about objects and entities by allowing interaction and displaying media related to the entities upon being tapped.

Another newer research area is e-learning with its example in [25]. In contrast to the traditionally used video files, hypervideos as a multimedia files are used, which can be navigated by using links that are embedded in them. Students can therefore easily access content that explains and clarifies certain points of the lectures that are difficult to understand, while at the same time not interrupting the flow of the original video presentation.

The principles of ambient media are: manifestation, morphing, intelligence, collaboration and experience, as presented in [13, 14, 17–23, 36], and used also in the SAME workshop papers [16, 27, 29, 31, 32, 37, 39, 43, 46].

Apart from the Semantic Ambient Media Experience (SAME) workshop there are other events dealing with the ambient media. One example is AMBI-SYS—International Conference on Ambient Media and Systems [2], however, it is not specialized on the semantic ambient media as the SAME is.

Research in ambient media is constantly increasing and evolving. There are many visions, such as *The Future is 'Ambient'* [12], and many works available in the related field of *'New Media'*. One of the most comprehensive works has been undertaken by Manovich in his book *The Language of New Media* [24]. However, his viewpoint on new media is more inclined to the film side, which represents the current dilemma of the content industry: the content industry (e.g. movie producers) start slowly to understand new media and the new media industry (e.g. Yahoo! [44]) slowly starts to converge with old media. The most comprehensive description of ambient media—or ambient intelligence—can be found in the ISTAG reports published by the European Union in [8, 9].

2.1 The Semantic Ambient Media Experience (SAME) workshop series

For the last three years, the Semantic Ambient Media Experience workshop series have attracted researchers and practitioners from many fields including education, business, government, technology, and media in order to discuss and shape ambient media ([21, 22]). The SAME workshops have been designed as a think-tank for creative thinkers and therefore have a special format which aims at team-work and collaboration towards envisioning the future of ambient media.

Thus, the workshop aims to answer to the challenges how to select, compose, and generate ambient content; how to interpret content for the ambient presentation; how to re-use ambient content and learning experiences; what are the characteristics of ambient media, its content, and technology; and what are ambient media in terms of story-telling and art. And finally, how do ambient media create business and value and how can ambient media be integrated into business processes and strategies.

In addition, semantics plays a crucial role in the generation of ambient media content. It can be seen as the glue between the raw data and the ambient media. Therefore we are interested to see innovative ideas how data can be (semi)-automatically interpreted and translated into media presentations. The workshop series led to the establishment of the Ambient Media Association (AMEA, http://www.ambientmediaassociation.org/).

3 A four-leave flower concept for discussing and analyzing ambient media

3.1 The flower concept

After thoroughly reviewing the state of the art of the field and the European Union's ISTAG Scenarios for Ambient Intelligence [8, 9], co-chairs of the SAME workshop selected the following topics as the key aspects of the semantic ambient media:

- Business,
- Content and media,
- Interactive design and experience,
- Models, methods, concepts, and frameworks.

They were chosen in order to encourage focused discussions as well as to offer a broad view of ambient media span and implications. In order to provide easier discussions, we formed them as flowers, in which each leaf is associated to a different aspect of media, as shown in Fig. 1.

3.2 Statistical analysis to support the flower concept

On the special issue following the previous Semantic Ambient Media Experience workshop in Multimedia Tools and Applications [20, 36], we performed the statistical analysis to support the flower concept.

In the analysis we checked, in how many papers the four aspects were mentioned.

Nine papers were included in the study. After the stemming process of the aspects we got the results, presented in Table 1.

From the results we can observe that each aspect of the flower model was in average mentioned in 7.75 and 6.5 out of 9 documents if the relation between the words of the aspect was *logical or* and *logical and*, respectively. Also the standard deviation is in both cases relatively small. From the results we can conclude that the flower concept was the right

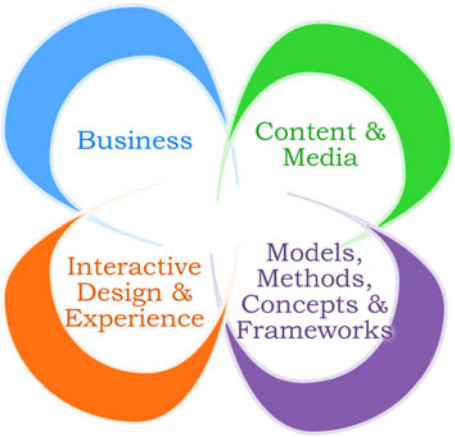

Fig. 1 Four-leave flower for analyzing and discussing semantic ambient media

Table 1 Statistical analysis to support the flower concept

	Business	Content and the media	Interactive design and experience	Models, concepts, methods and frameworks	Average	Standard deviation
and	8	8	7	8	7.75	0.43
or	8	7	6	5	6.50	1.12

choice, since all four aspects of the flower model are very much and equally used in the state-of-the-art literature of the field.

3.3 Method of the study

The work and analysis presented in this paper are based on 9 workshop contributions [16, 27, 29, 31, 32, 37, 39, 43, 46]. Each contribution was presented and discussed during the workshop and each participant was invited to express his/her view on the presented works. Such approach was adopted in order to generate extensive and detailed discussions that finally led to numerous new ideas. Each presenter, together with the audience, tried to answer questions related to the four main topics of semantic ambient media in regards to topics presented.

After collaboratively filling in the leaves of the flower for each presentation, participants rated the leaves on a 1–5 scale, where 1 meant that the topic was weakly covered and 5 meant that the topic was strongly covered. This method integrates naturally with the SAME workshop, which is not intended to be a mini-conference but instead to focus on discussion and collaboration. Also, each contribution was analyzed and examined on the potential impact it had on ambient media and three thematic groups emerged:

- Delivery, display, and perception of ambient media,
- Innovation and design of ambient media,

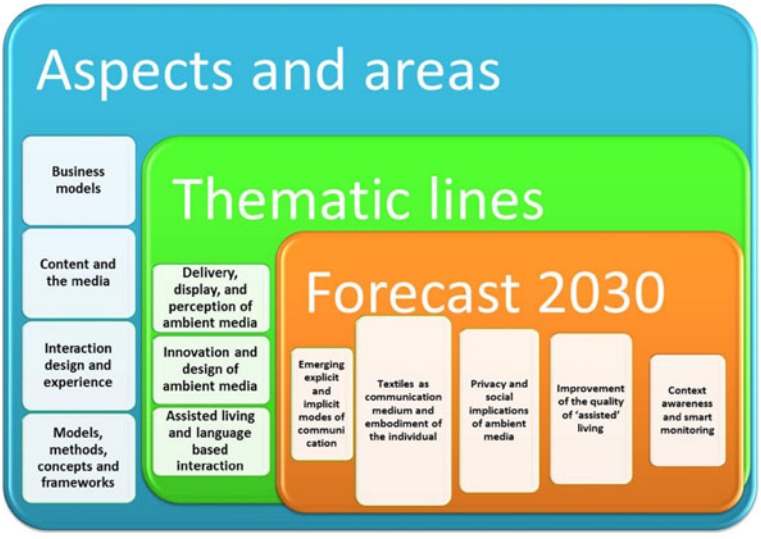

Fig. 2 Overview of the thematic issues addressed within the scope of this paper

- Assisted living and language based interaction.

These thematic lines have been evaluated on potential business models, content and the media, interaction design and experience, and basic models. Figure 2 gives an overview of the input and results of the discussions.

Participants were then divided into the three groups and encouraged to discuss and analyze the concepts as well as the relationships covered by each group. The groups were formed in the following way:

1) Each participant should join others with similar works;
2) If one participant's flower had a weak leaf in one topic, the participant should join a group where someone had a flower with a strong leaf in the same topic.

The goal was therefore to form three groups where all the leaves (topics) of the flower were adequately covered. In order to guide the participants and to maximize the benefit of these discussions, the four-leave flower metaphor was used. To sum up the discussions, each group had to develop a visionary scenario for ambient media, and pinpoint to the major trends for ambient media in the next decade.

We describe the findings from each group in the following subsections.

3.4 Delivery, display, and perception of ambient media

Svahn introduced a relationship between ambient media and pervasive games [39] which tries to open up both fields to an analysis with the heuristic-systematic model of persuasion based on the relationship between the two fields. The arguments presented invite further discussion on the relationships between the ambient media user experience and the kind of brand equity, as measured by the two-tiered persuasion model that ambient media can build. When analyzing such relationships using the flower model, the group participants came up with the following observations as briefly illustrated in Fig. 3:

- Intrinsic quality,
- Systematic way of thinking vs. mysterious design,

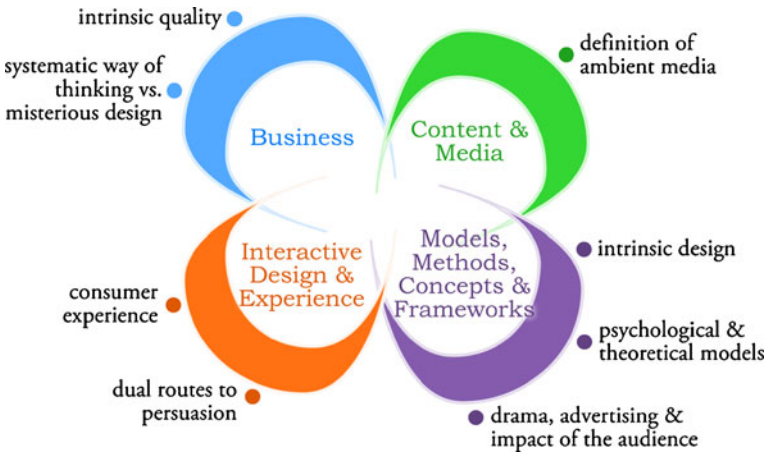

Fig. 3 Four-leave flower for the relationship between ambient media and pervasive games

- Consumer experience,
- Dual routes to persuasion,
- Intrinsic design,
- Psychological and theoretical models,
- Drama, advertising and impact of the audience.

Peiris et al. [30, 31] discuss a novel non-emissive animated fabric technology that is fast, color changing, and robust (AmbiKraft). The technology combines thermochromic ink with semiconductor heating/cooling technologies, embedded in soft fabrics. By developing a technology that makes the fabric itself change the color they present it as a ubiquitous and ambient display technology. Their results are presented through a various range of animated fabric display prototypes. The four-leave flower of this work is shown in Fig. 4 for which the key words are listed below:

- Fashion industry,
- Business models targeted for consumer groups,
- Decorations,
- Human-to-human mediated interaction etc.

Oksman et al. [29] describes empirical studies on end users' experiences of peer-to-peer (P2P) networked television services. In order to explore the quality of user experience and content consumption in the evolving TV system, the authors have developed a peer-to-peer social media service prototype. The prototype can be used both with regular home computer networks and on mobile devices, providing users a real pervasive, ambient media experience. The authors' primary goal is to create an understanding of the factors that shape P2P TV experience as a basis for the future design of NextShare, a peer-to-peer social media service. Through this research, they conclude that P2P technology can provide a reliable mechanism for ingestion of time-based TV program as well as video-on-demand (VOD) content via the internet. P2P technology is especially suitable for large media content providers. However, in order to create a real business value out of the service, new, innovative content production

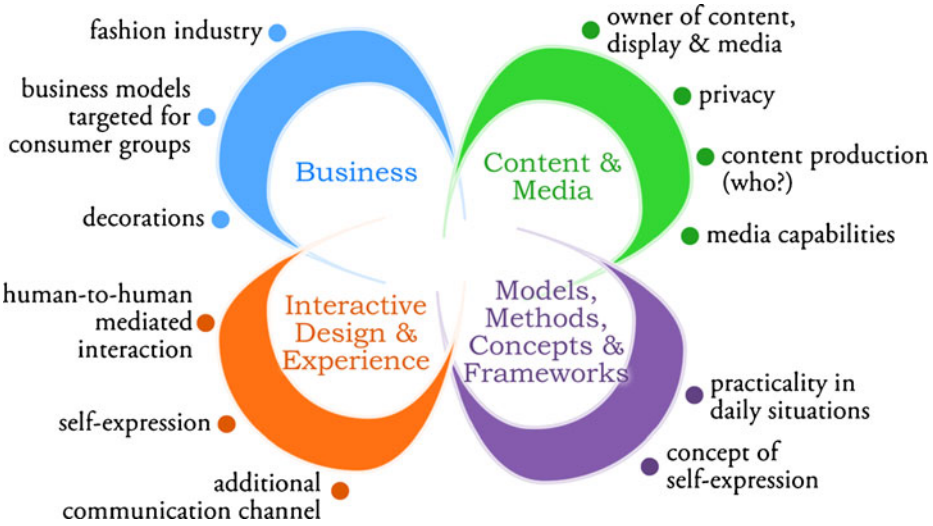

Fig. 4 Four-leave flower of ambient display textiles

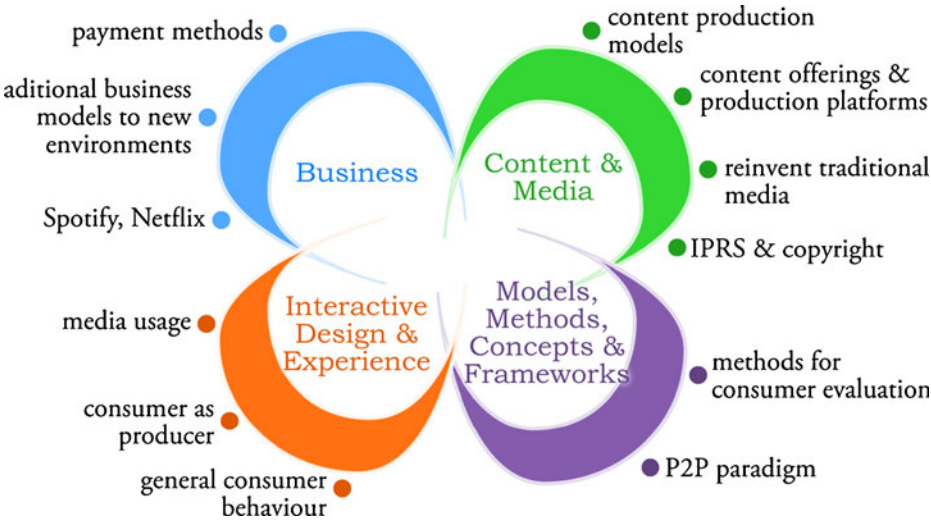

Fig. 5 Four-leave flower of the TV content delivery and user experience

models and types need to be developed. The four-leave flower of this work is shown in Fig. 5 and these key words describe it the best:

- Payment methods,
- Additional business models to new environments,
- Content production models,
- Content offerings and production platforms, etc.

A paper *Automatic Speech Recognition—An Approach for Designing Inclusive Games* by Moyen Mustaquim [26] fits perfectly into this group, although not presented at the workshop. It discovered that although computer games are now a part of our culture, certain categories of people are excluded from this form of entertainment and social interaction because they are unable to use the interface of the games for various reasons, e.g., deficits in motor control, vision or hearing. It proposes automatic speech recognition systems (ASR) and voice driven commands to be used to control the game, which can thus open up the possibility for people with motor system difficulty to be included in game communities.

The paper aims at finding a standard way of using voice commands in games that uses a speech recognition system in the backend, and that can be universally applied for designing inclusive games. Present speech recognition systems, however, do not support emotions, attitudes, tones etc. This is a drawback because such expressions can be vital for gaming.

The study takes multiple types of existing genres of games into account and analyzes their voice command requirements. Based on this, a general ASR module is proposed which can work as a common platform for designing inclusive games. For instance, if a command is spoken in low pitch the character in the game acts differently than when it is voiced in an elevated pitch. The standard voice-driven module is based on an algorithm which can be used to design software plug-ins or can be included in a microchip, that can be integrated with the game engines; creating the possibility of voice-driven universal access for controlling games.

3.5 Innovation and design of ambient media

Lugmayr [16] showed that innovations in the media business have a long history, as new technologies let new forms of media emerge. Today, in the world of ubiquitous and pervasive computation, this technology lets a new form of media emerge: ambient media. One simple example are public screens where people can interact with the displayed content. The aim of [16] is to discuss ambient media as innovation driven by entrepreneurs in the world of media, the principles and how they can be managed, as well as what is needed to make them successful. However, at this stage solely the research design is presented within the scope of [16], as the research work is currently in progress. As examples act entries submitted to the Nokia Ubimedia MindTrek Award [15] that were assessed by conducting interviews and analyzing the entries of the winners of the competition.

Vatavu [41, 43] described challenges in designing interactions for the new age of ambient media. The discussions tried to develop an understanding of technologies and techniques that are most suited for interacting with ambient media. There are many computing trends emerging today ranging from desktop or mainframe scenarios up to mobile solutions and ubiquitous computing preferred by on-the-run consumers. Developments in processing and communication technology have been accompanied by the introduction of new interactive devices as well as interaction techniques which are needed in order to provide usability and make such technology advancements available and accessible for end users. The author discusses current practices for interacting with ambient technology with a special focus on using mobile devices and natural gestures for interfacing public ambient displays. A major concern when interacting in ambient environments regards the awareness of the interaction opportunities or the capacity of an ambient system to advertise its interactivity in an intuitive manner for its potential users and consumers. The position paper addressed two important questions related to these aspects: how can users tell whether a particular ambient display is interactive or not? And, if interactivity is assumed, how can users tell what the interface is and what are the interaction techniques? Such questions regarding advertising interactivity

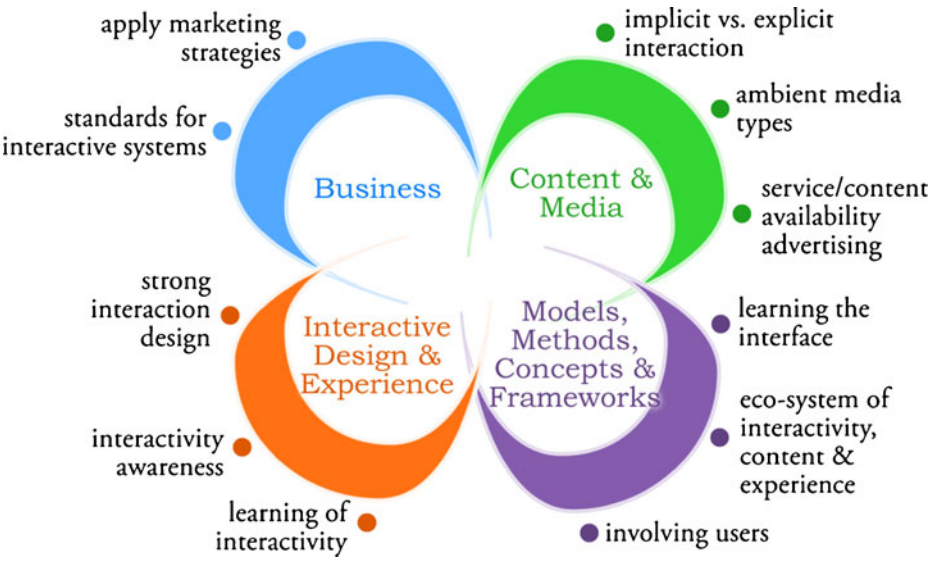

Fig. 6 The flower concept for designing interactions in the age of ambient media

or exposing affordances become of extreme importance in a world in which ambient displays are becoming more and more prevalent. The main observations in accordance to the flower concept are illustrated in Fig. 6:

- Apply marketing strategies: one suggestion to expose the affordances of possible interactions of ambient displays was to use well-established practices from marketing research that strive for user attention. Applying market strategies and defining, validating, and making use of standards for interactive systems could improve the interactivity awareness of an ambient display with strong connections to the business and the industry;
- Implicit vs. explicit interaction: ambient displays offer opportunities for designing both implicit and explicit interactions; the design of either one is strongly related to the awareness cues which are made available. The type of interaction (implicit/explicit) may be associated to the type of content being exposed and available in the environment suggesting a natural relationship between content and interactivity;
- Interactivity awareness and learning the interface: current public ambient displays suffer from interactivity awareness problem: how can people tell whether a display is interactive or not? And, if it is interactive, how can they tell what the interface is? The interactivity of a system should be advertised so that potential users and consumers would be aware of such possibility. Also, how users learn to interact with new never-seen-before ambient displays remains a challenge;
- Involving users: many design decisions are taken by carefully observing users as well as by including users during design (participatory design) which can be applied to designing ambient public display interactions as well.

3.6 Ambient assisted living and language based interaction

Pogorelc and Gams [32, 34, 35] presented a generalized approach to detect health problems and falls of the elderly for the purpose of prolonging autonomous living of elderly using semantic ambient media. The movement of the user is captured with the motion capture system, which consists of the tags attached to the body. The coordinates of the tags are acquired by sensors situated in the apartment. Output time-series of coordinates are modeled with the proposed data mining approach in order to recognize the specific health problem or fall. The approach is general in a sense that it uses the k-nearest neighbor algorithm and the dynamic time warping with time-series of all measurable joint angles for the attributes instead of the more specific approach with medically defined attributes. It is a two-step approach; in the first step it classifies a person's activities into five categories including different types of falls. In the second step it classifies walking patterns into five different health states; one healthy and four unhealthy. Even though the new approach is more general and can be used to differentiate also from other types of activities or health problems, it achieves very high classification accuracies, similar to the more specific approach. Figure 7 presents the flower that sustains this topic for which the main observations were:

- Systems availability,
- Autonomous assisted living,
- Spread of people/locations,
- Can ambient content be prioritized?

Stojmenova et al. [37, 38] presented an application called med-reminder that could be used in an interactive TV system. The application is intended for reminding people to take their medicines on time and in a correct way. Users, elderly people, are also able to call

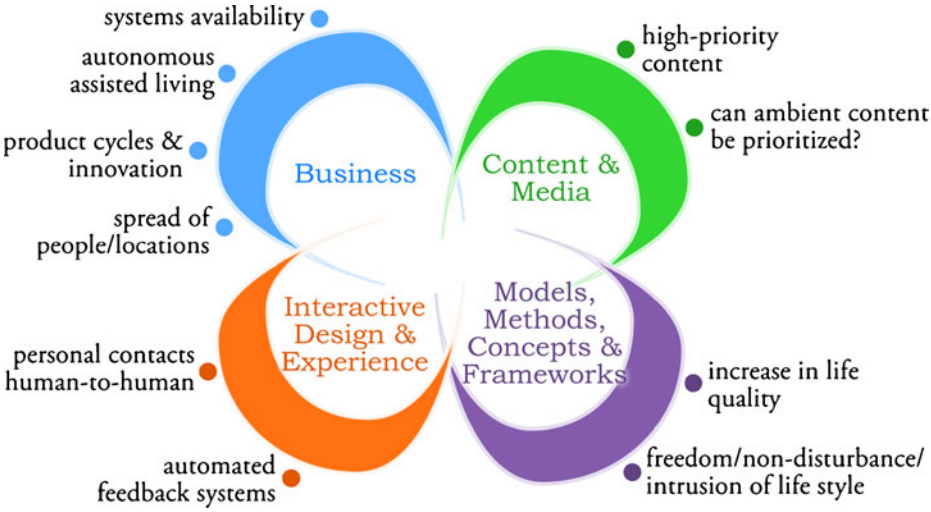

Fig. 7 The flower concept for prolonging autonomous living of elderly with semantic ambient media

medical personnel or a relative in case of emergency, simply by clicking on a key on the remote control. The goal of the work was to design an application with a user interface that would overcome the usual drawbacks of applications for the elderly that incorporate advanced technology achievements. For evaluating the graphical user interface, navigation and general usability of the application a methodology for usability evaluation study was designed and presented in the paper. If med-reminder is adopted, it may contribute to preventive care improvement as well as diagnosis and treatment enhancements that would consequently lead to reduced consumption of resources and materials that are part of the process of implementing health care. The flower model is illustrated in Fig. 8:

- Business models for partners,
- Macro-economic aspects,

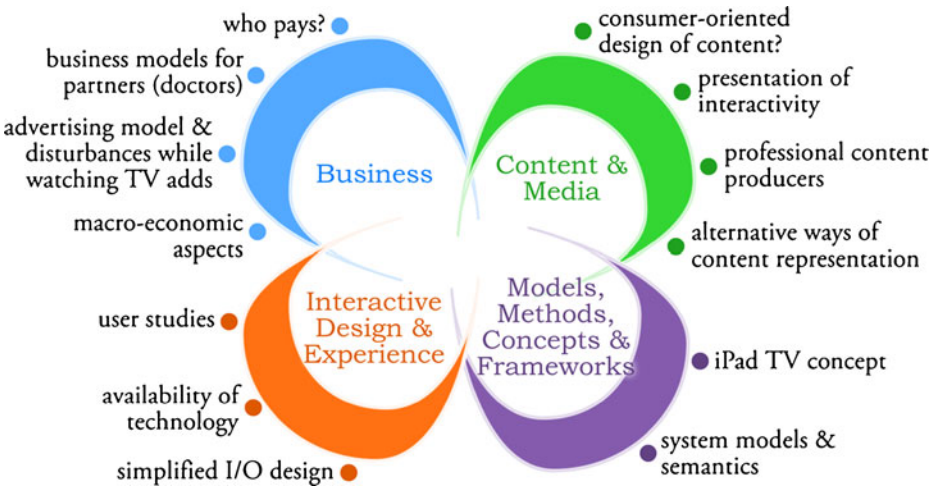

Fig. 8 The flower concept for assisted living solutions for the elderly through interactive TV

- Availability of technology,
- Consumer-oriented design of content.

Zenz et al. [45, 46] presented a solution for providing language evolution knowledge "on the go". Knowing about the evolution of a term can significantly decrease time needed for searching for information. It can also aid in quickly getting a broader overview, which is essential when one is on the move. The aim of the tool is to help users discover unknown, historic senses of a term e.g., the word "nice" meant "foolish" or "stupid" in the 13th century. It should also help to find terms that were previously used to express the sought term, e.g., "automobile" was used instead of "car" and "Leningrad" instead of "St. Petersburg". The authors present a mobile interface for easy access and visualization as well as an overview of how this evolution was found. Figure 9 illustrates the flower model dealing with these problems:

- Context sensitive adds,
- Context sensitive search,
- Reduction of information overload,
- Semantic nets.

4 Future research on semantic ambient media

An ensemble of envisioned scenarios of ambient media emerged as they were discussed by the three working groups:

- Explicit vs. implicit communication
- Textiles as communication medium and embodiment of the individual
- Privacy and social implications of ambient media
- Improvement of the quality of ambient-assisted living
- Context awareness and smart monitoring

We discuss each vision below.

There is an additional scenario "Unobtrusive Semantic Ambient Media", influenced by EyeRing from the Fluid Interfaces group, described in the last subsection.

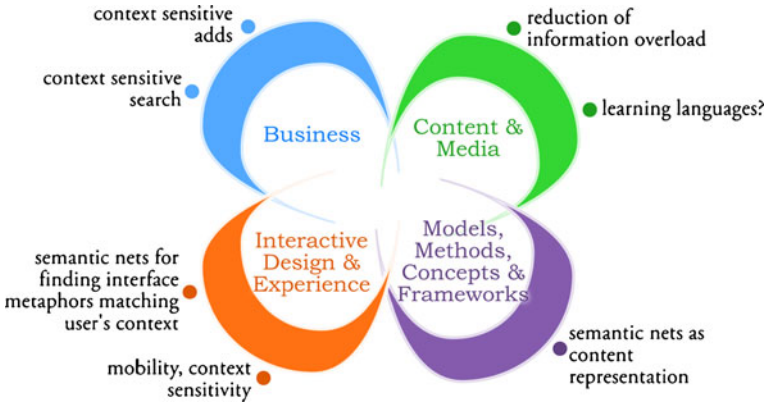

Fig. 9 The flower concept for the relationship between language evolution and ambient media

4.1 Emerging explicit and implicit modes of communication

A further investigation of the communication acts performed within the depicted system suggests that in order to reduce complexity, it helps to distinguish between explicit and implicit information. This concept is inspired by terms defined in the APML specification [3] which attributes all machine-inferred information as *implicit*, whereas *explicit* attributes information the user asked for. Or to re-phrase it: implicit information is data that might be relevant to the user, whereas explicit information is what the user thinks is relevant to him. The working group suggests to present implicit information in an ambient, non-disrupting mode, using rather abstract or coded information. Table 2 summarizes these findings.

Applied to the depicted system, the textile display would carry implicit information, while stationary displays and terminals or mobile devices would be used to access explicit information. In a simple routing application imagine a young person getting information on how to get to a concert place. Instead of a route, the simple answer would be to follow the blue T-Shirts, which is easy to do without being distracted by looking up a map on a device. The implicit vs. explicit content modes model gives exciting perspectives on what the content of ambient media could be and how ambient media could be used to enhance the user experience of existing, ubiquitous but disrupting media.

4.2 Textiles as communication medium and embodiment of the individual

Many new perspectives relating to the active use of textiles have been identified within the discussions of the workshop. Textiles can be seen as new device for interaction. If seen as means of communication, textiles have a bridging character between multiple contexts. The owner wears them in the private and in the public sphere. They can be used to communicate individual attitudes or endorse messages from third parties the wearer identifies himself with. They can embody individual memories that are only known to the owner's social peer group. One distinct person is the gatekeeper for all information displayed on the textile and the information is always interpreted with respect to the wearer, as opposed to other kinds of public displays such as billboards, interactive kiosks and traffic information displays. Now that rendering information on this display in near-real time, a diligent investigation is needed

Table 2 Features of implicit and explicit modes of communication

Implicit mode	Explicit mode
• Does not disrupt the stream of attention	• Disrupts current stream of attention
• Blends seemlessly with real world	• Opens window to a virtual world
• Processed with back-of-mind attention [5]	• Processed with front-of-mind attention [5]
• Gives user decent clues as affirmative feedback of his current course of actions	• Consumed to initiate or change a new course of actions
• Gives gently suggestions of new options for action	• Sets context for interpretation of implicit information
• Tendency towards abstract, coded information	• Tendency towards concrete and condensed information
• Favours ambient media with subtle presence	• Favours high presence public media
• Favours slow and multimodal displays	• Favours fast visual displays
• Tendency to address "Right Brain"?	• Tendency to address "Left Brain"?

to identify which content would suit this most personal of all thinkable public display types and how it could relate to other kinds of public displays.

Three main applications seem reasonable for the textile display. Note that a lot of those applications, already common today, just use static information display in the form of textile print. First there is individual expression of emotion and opinion. Widely used there could be a decisive impact on public solidarity through empathy, but as well a more intense and visible public discourse on controversial matters. This could culminate in displaying social relations and even complete social media timelines. Second, there are business applications. From a simple "sandwich man 2.0", renting his T-Shirt Space to companies to personal endorsement of products and services. However, the range of applications is not limited to marketing use cases. Third is public information, which includes applications such as traffic routing. Imagine a number of pedestrians on their way to a large venue where presumably a lot of other people are heading to as well. Whereas right now you are usually guessing whether you are following the right stream of people, a T-Shirt display could show you exactly which people to follow. Whereas a stationary display can only tell you where to go, a textile displays could actually tell you to just follow. Or, in order to make best use of the individual strengths of the different display types, use the stationary display to identify which textile design to follow. Textiles might be more suitable to give subtle clues than to convey large messages in text.

The medium described is not an interactive one so far. Monitoring attention and gestures can add the feedback needed to turn the network of stationary public displays and moving personal public textile displays into a dynamic mesh of both ambient and very present information. While stationary displays would rather rely on motion detection or eye tracking, the textile could be extended to capture typical gestures of human social interaction. These gestures include shaking hands, hugs, thumbs up, pointing or back padding. Social media platforms such as Facebook make heavy use of these metaphors, following the increasingly popular paradigm of playfulness. It is only a natural consequence to turn this into a powerful interface, introducing feedback channels between social platforms and the depicted dynamic display mesh.

4.3 Privacy and social implications of ambient media

Ambient media deal with a huge amount of personal information, either when applying technology related to ambient assisted living, or when utilizing smart textile without a doubt a drastic impact on privacy, creates invaluable opportunities of social interaction as well. Existing services like *foursquare* and *aka-aki networks* try to catalyze conversation and social networking by status, profile and location of the user. Yet each contact takes a number of prerequisites: both persons need to subscribe to the same platform, have their mobile and the application turned on and must bother to use it at the same time in the same place. The textile display does overcome those limitations. Only one matchmaking partner needs to use it and it is immediately accessible to all people in the near environment (or even in quite a distance, if you just go for showing a color code).

4.4 Improvement of the quality of ambient-assisted living

Another vision for ambient media is a future system for increasing the quality of living in elderly home environments. Such a system should use a natural language based voice communication system between the user and the system as such. Especially as voice communication is a natural way of conventional human-to-human

communication; it is particularly suitable for elderly or people with special needs. Besides monitoring user behavior and alarming in case of detected abnormality, such system should also include reminders for the users to take medicine, to eat, and to keep themselves active.

A novel contribution of Bogdan Pogorelc and Matjaž Gams to the ambient-assisted living is presented in the paper *Home-based health monitoring of the elderly* [35]. It proposes data-mining algorithms in a system for the automatic recognition of health problems through the analysis of gait. The gait of the elderly is captured using a motion-capture system and the resulting time series of position coordinates are analysed with a data-mining approach in order to classify the captured gait into: 1) normal, 2) with hemiplegia, 3) with Parkinson's disease, 4) with pain in the back and 5) with pain in the leg. The study proposes and analyzes four data-mining approaches: 1) CML—Classical machine-learning approach with raw sensor data, 2) SCML—Classical machine-learning approach with semantic attributes, 3) MDTW—Multidimensional dynamic time-warping approach with raw sensor data and 4) SMDTW—Multidimensional dynamic time-warping approach with semantic attributes.

Especially natural language processing methods as e.g. proposed in [46] could be useful for finding similar diseases and/or medications. Here one example would be in the case of generic medications. It may happen that the user needs to buy medication in a foreign country where he/she does not know the name. However, by knowing some generic name or the name of some substances from the user's own country, language connections can help the user to find similar medications. A second use case for the ideas presented is to aid elderly people in their everyday interactions with younger people using the technology which is nowadays mainly used by younger. With the introduction of the web, in particular user generated content, language evolves faster and faster making it difficult for most, in particular elderly, to keep up. New terms pop up and others change meanings, e.g., surfing, texting, IM, cool etc. Language connections can help clarify meanings of previously unknown or changed terms used on the web and thus make the interactions between elderly people and the web go smoother.

4.5 Context awareness and smart monitoring

Context awareness and smart monitoring is the key for any smart interaction, either in the case of ambient-assisted systems, interactive textiles, or smart public displays. There are several requirements to be fulfilled in the design of context aware systems, where a good interactive system should be able to adapt to: situation (e.g., at home, in the nursing facility), person (e.g., healthy elderly, patient) and disability (e.g., hearing, seeing and walking problems). In case that alarming behavior, e.g. in ambient-assisted living environments is detected, the system should provide communication with the elderly in person as well as notifying emergency services. For monitoring the elderly, combination of various sensors seems to be the best approach, since each of them gives different type of important information.

For at-home-rehabilitation scenario, the system should behave differently than for the monitoring. In case of rehabilitation after brain stroke, a user should regularly perform exercises prescribed by his/her medical doctor. In this particular case the system should monitor the user's exercises in real time and tell him/her if he/she is performing exercises correctly or if something can be improved. If, from the performing of exercises, the system could not detect the progress, it should notify the user and advise him/her to visit a medical doctor. Since people after a stroke tend to be unstable and to fall, the monitoring should also be provided.

4.6 Unobtrusive Semantic Ambient Media

Nowadays it is still common to use the interface of a keyboard and mouse invented few decades ago, to interact with digital information, although it severely constrains our ability to access and interact naturally with digital content. Computer systems lack the contextual knowledge to offer relevant information when and where we need it. Moreover, traditional screen-based interfaces divert our attention in mobile and social situations. They are designed for a single user, and not well suited to accommodate collaborative activities.

New interfaces should be designed to integrate digital content in people's lives in more fluid and seamless ways. It should be easier and more intuitive to benefit from the wealth of useful digital information and services.

A step into the direction of this vision is the work of Radu-Daniel Vatavu [42], which represents nomadic gestures as a technique for reusing gesture commands for frequent ambient interactions.

Although the age of ambient intelligence has already incorporated gestures into practical applications with the goal of delivering adaptive and personalized interactions, practitioners are faced with many problems when implementing gesture-based interfaces for such interactive ambient systems. Gestures offer great opportunity for natural and intuitive interactions, but there are currently little to no rules for creating the set of gestures for a given application. Therefore, designers associate gestures and functions by relying only on their own expertise and experience which leads to different systems exposing different standards.

His work introduces a novel concept (nomadic gestures) for reusing a set of user-defined gesture commands in the context of interacting with ambient systems. Nomadic gestures live on each user's mobile device and are uploaded to the ambient system prior to interaction. The concept relies on an important shift of perspective strictly adhering to the goals of ambient intelligence: "It is not the users that adapt to the interface learning its commands but instead the interface employs the users' own gesture sets with their own preferred function associations!"

Another step is the paper [40] that introduces the implementation of a novel concept for a home entertainment system together with an affordable controlling interface that uses point & click interactions in order to create, mix and manipulate media screens within the same projection-based display. It also supports collaborative interface, since the scenarios for single and multiple viewers are discussed with users being able to create, reposition, resize, and control their own-defined media screens. Using a motion-sensing remote controller, the standard interaction techniques are transferred from PCs to home entertainment. An optional system feature is described for the automatic configuration of such media screens by analyzing the home environment using computer vision techniques. Observations from initial user studies are reported with regards to the perceived usefulness and acceptability of the proposed system.

The main benefit introduced by [40] is that a large entertainment display becomes shared and personalized while it is being adapted and fit into the home environment using novel Unobtrusive Semantic Ambient Media interfaces.

5 Summarizing the flower concept

The four aspects of the flower concept can be summarized with the following questions:

1) **Content and the media:**

   a) What is 'content' and how can it be presented in the age of 'ubiquitous' and 'pervasive'?
   b) How to select, compose and generate ambient content?

c) How to interpret content for an ambient presentation?
d) How to manage and re-use ambient content in specific application scenarios (e.g. e-learning)?

2) **Interaction design and experience:**

a) What is interactivity between the single consumers and the consumer groups in the ambient context?
b) How can collaborative or audience participatory content be supported?

3) **Models, methods, concepts and frameworks:**

a) How can sensor data be interpreted and intelligently mined?
b) How can existing media such as TV, home entertainment, cinema be extended by ambient media?

4) **Business models:**

a) How can ambient media be applied in business processes?
b) How do ambient media create value and business?
c) Business opportunities and strategic issues of ambient media?
d) Which methods for experience design, prototyping, and business models exist?
e) What means Quality of Experience (QoE) in the context of ambient media?

6 Conclusion

This paper reviewed the Semantic Ambient Media Experience (SAME) domain by analyzing studies using the flower model of Business, Content & the Media, Interactive Design & Experience and Models, Methods, Concepts & Frameworks. The explained discussions were raised as the result of the group working of the SAME participants. In addition, scenarios of ambient media for the next decade have been envisioned as challenges to be confronted in the future ambient media.

As further work, alternatives to the flower model can be studied and compared with it.

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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., 1st 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.

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, TVand 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.

Björn Stockleben was awarded his master's degree in Media Sciences, Media Technology and Computer Sciences from Technical University of Brunswick and Brunswick School of Arts in 2003. For Rundfunk- Berlin Brandenburg he has been acting as technical manager in EC- and ESA-funded research projects such as IST-INSTINCT, IST-ENTHRONE and ARTES-COTV. He is an expert in participative media, interactive service authoring and non-linear AV media. Currently he works as scientific coordinator for the new master program "Cross Media", which combines management, journalism and interaction design at University of Applied Sciences Magdeburg-Stendal. He lectures in media theory at University of Applied Sciences Bremen and human-machine interaction at Technical University Brunswick.

Radu-Daniel Vatavu is with the University Stefan cel Mare of Suceava, Romania. He holds a PhD in Computer Science from the University Stefan cel Mare of Suceava and from the University of Sciences and Technologies of Lille, France in the domain of gesture recognition. His research interest is Human-Computer Interaction with focus on novel interactions, gesture-based interfaces, and ambient intelligence.

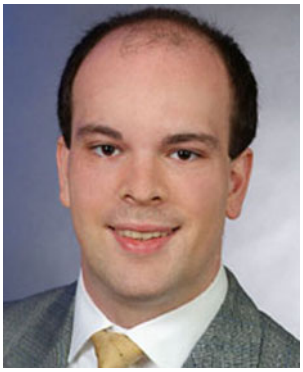
Nina Tahmasebi is a Ph.D. student at L3S Research Center in Hanover. She holds a Bachelor of Science in Mathematical Statistics since 2007 from Göteborg University and a Master of Science in Engineering Mathematics since 2008 from Chalmers University of Technology. She is currently working on the FP7 ARCOMEM project and has previously been involved in the LiWA project. Her research interest are mathematics and mining algorithms for language evolution tracking.

Estefanía Serral is a post-doctoral researcher in the Christian Doppler Laboratory, Software Engineering Integration for Flexible Automation Systems (CDL-Flex) at the Vienna University of Technology. Until July 2012, she worked as a senior researcher in the Center for Research in Software Production Methods at the Universitat Politècnica deValència. Her research interests include semantic integration, model-driven development, context-awareness, pervasive computing, model evolution, and task automation. She has published several contributions to well-known international conferences and scientific journals such as The Computer Journal, CAiSE, PMC, ISD, UIC, AmI and ERCIM. Serral has a MS and a PhD in computer science from the Universitat Politècnica de València. Contact her at estefania.serral@tuwien.ac.at.

Emilija Stojmenova is user experience manager in Iskratel where she is responsible for the innovation of new services, solutions and products, as well as the coordination of design and development following user-centred approaches. She is additionally finishing her PhD thesis about user-centred design methods modification for multi-screen applications for elderly people. Additionally I work on different national and European research projects. She received the Rector award as the best graduate student in electrical engineering at the University of Maribor. In June 2011 she received a bronze award for her innovation "Integrating user experience in the product development lifecycle" by the Chamber of Commerce and Industry of Slovenia. Since January 2012, she has been additionally employed by the Faculty of information studies from Novo mesto, Slovenia, where she– User Experience, User Interface Design and Informatics. Her community engagement includes: WUD Slovenia 2010, WUD Slovenia 2011 and WUD Slovenia 2012 Conference Chair, UXPA Slovenia director and IEEE WIE Slovenia president. She is also a member of IxDA Slovenia, IEEE, ACM, and UxPA.

Bojan Imperl has graduated in 1994 at the Faculty of Electrotechnical Engineering and Computer Science, University of Maribor. He holds a M.Sc. (1997) and a PhD (1999) both in electrotechnical engineering. He has been working as a full time researcher at the University of Maribor (until 1999) on the area of automatic speech recognition, specializing in acoustical speech modeling. Following his studies at University of Maribor, he spent 5 years as Project Manager in a software development company HERMES SoftLab planning and managing various projects within the Telecom sector. He joined Iskratel in 2004 as a product manager for the NGN services. He is also holding a position of an Associated Professor at the University of Maribor teaching various courses in telecommunications.

Thomas Risse is the deputy managing director of the L3S Research Center in Hanover. He received a PhD in Computer Science from the Darmstadt University of Technology, Germany in 2006. Before he joined the L3S Research Center in 2007 he lead a research group about intelligent information environments at Fraunhofer IPSI, Darmstadt. Currently he is the scientific and technical director of the FP7 ARCOMEM project on Web archiving using social media information. Thomas Risse's research interests are semantic evolution, data management in distributed systems, and self-organizing systems. He serves regularly as program committee member or project reviewer. He published several papers at the relevant international conferences.



Gideon Zenz student at L3S Research Center in Hanover. He holds a M.Sc. in Computer Science since 2008 from Leibniz University of Hanover. He is working on the FP7 ARCOMEM project and others since 2008. His special interests are databases, algorithms, and search technology.

Prof. Dr. Matjaž Gams (http://dis.ijs.si/Mezi/) is Head of Department of Intelligent Systems at the Jozef Stefan Institute and professor of computer science at the University of Ljubljana and MPS, Slovenia. He is or was teaching at 10 Faculties in Slovenia and Germany. His professional interest includes intelligent systems, artificial intelligence, cognitive science, intelligent agents, business intelligence and information society. He is member of numerous international program committees of scientific meetings, national and European strategic boards and institutions, editorial boards of 11 journals and is managing director of the Informatica journal. He was co-founder of various societies in Slovenia, e.g. the Engineering Academy, AI Society, Cognitive Society, ACM Slovenia. He is president of institute and faculty union members in Slovenia. He headed several national and international projects including the major national employment agent on the Internet first to present over 90% of all available jobs in a country. His major scientific achievement is the discovery of the principle of multiple knowledge.