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Ambient Media

Artur Lugmayr

Media stimulate human senses by using different kinds of technologies in many arbitrary forms. A few examples are television, printing, the Web, and magazines. Each of these examples has different underlying principles, technologies, and languages for transmitting information and interacting with the medium or with other humans. Today, ever more ubiquitous and pervasive technologies are available and act as a medium to interact and transmit information to humans. In this article, we present a new form of ambient media, where the media as such are embedded into the natural human environment. In simple terms, the article tries to answer the questions "What happens if the interface between the medium and the components of the natural environment continues to vanish; which technology is used, and how do humans respond to these trends". It is simply Ubimedia or Ambient Media.

Keywords: Ambient Media, Ambient Intelligence, Bio-media, Media Environments, Smart Media, Ubiquitous Computing.

1 Introduction

To introduce the new field of Ambient Media¹ or Ubiquitous Media, first of all let us look at what media actually are. We can define media as the technology, form, and content used to communicate and interact with information, knowledge, or wisdom. The spectrum of understanding helps us to understand how humans process and understand the outside world [1]. From the viewpoint of this definition, the various media act as doors to human understanding of the outside world via artificially created technology. Media are the interface to the spectrum of human understanding, and their underlying technologies have undergone a tremendous change over the centuries: from cave-paintings, to the printed book, to the Web, right up to today's ubiquitous computing. Media are present in each case and the basic principles remain the same: communication and interaction.

Data is the raw material for information so, in computer terms, data is simply bits and bytes – encoded information. Data is human unreadable and usually used at a system or production level. Information itself is the means of communication and the carrier of the message encoded within

¹ According to Wikipedia "Ambient Media started to appear in British media jargon around 1999, but now seems to be firmly established as a standard term within the advertising industry. It is the name given to a new breed of out-of-home products and services determined by some as Non-Traditional or Alternative Media. Ambient media advertising can be used in conjunction with mainstream traditional media, or used equally effectively as a stand-alone activity. The key to a successful ambient media campaign is to choose the best media format available and combined with effective message" <http://en.wikipedia.org/wiki/Ambient_media>.

Author

Artur Lugmayr describes himself as a creative thinker and his scientific work lies somewhere between art and science. His vision can be expressed as the creation of media experiences on future emerging media technology platforms. He is the head and founder of the *New Ambient MULTImedia* (NAMU) research group <www.cs.tut.fi/sgn/namu> at the Tampere University of Technology (Finland) which is part of the Finnish Academy Centre of Excellence of Signal Processing from 2006 to 2011. He holds 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 (UIAH, Helsinki). His private passion is to be a famous digital film-maker. <lartur@acm.org>.

data in a meaningful and organized form. All abstract schemes of exchanging messages, either based on human language, writing or graphical work is based on information. Information, therefore, is the abstract means of communicating between peers in a more structured and organized way. Each human interprets information and turns information into knowledge. Knowledge is the integration of information into other knowledge or pieces of information. Knowledge and experience can be placed at an equal level and give meaning to information. A more philosophical issue is wisdom, which can be seen as a kind of meta-knowledge.

1.1 Ambient Media or Ubimedia

The idea of ambient media or ubimedia goes back to the author, when he was re-thinking how the media of the future could be affected by ubiquitous-, bio-, and ambient technology in [2][3][4][5]. The underlying concepts are fairly simple: In the age of information technology, we have learned to work with data and how to structure data to in-

formation. Yet, we are not able to process knowledge or experience and are a long way from being able to process and understand wisdom, considering media from McLuhan's viewpoint - "*the medium is the message*", and "*media are human extensions*" [6] - rather than their content or form. Thus the technology used to communicate and interact with information is the greatest concern. In times of ubiquitous computing, more and more technology is transparent to its use. Ubiquitous technology is based on Mark Weiser's idea of calm or ubiquitous computing [7] [8], in which computational technology is added throughout the natural environment of humans. Computational resources are available anywhere, anyhow, and anytime to the consumer. However, they are transparent and invisible to humans. This leads us to the question "How does ubiquitous technology affect the changing media environment?".

1.2 Ambient Intelligence

Another term used to describe ubiquitous computing is ambient intelligence. Ambient intelligence is a more comprehensive and structured vision than ubiquitous or pervasive computing. Ambient intelligence addresses the whole spectrum of technology, from hardware to software components, in order to create smart environments for humans. As defined by European Commission's ISTAG (*Information Society Technologies Advisory Group*) [9] [10], the term ambient component refers to the hardware embedded in the natural human environment. In this case, ambient defines the fuzzy boundary between objects in the natural human environment spiced with the latest technology: smart colour changing wallpapers, the smart interconnected home, intelligent toys for kids, and assisted living technology for the aging. All these technology are embedded in the consumer's environment in a natural manner. Clearly many more aspects arising from aesthetic, design, and architectural considerations have to be taken into account when creating a habitable environment for humans. In the case of ambient media, the media technology used is based on ISTAG's vision of ambient intelligence.

1.3 What will Ambient Media Change?

Ambient media is changing the way we think about the media with which we are interacting, communicating, and turning information into knowledge. Existing media environments need to be rethought and the form of this new medium defined. Save for a few artistic installations, media environments have been distinguishable from the real world. However, with ambient media the boundary between the real world and the synthetic universe encompassed by the media environment is becoming less and less visible. What does the media environment of a smart fridge, intelligent toaster, and customizable set-top box actually consist of? One example is mass media in the shape of newspapers or television news broadcasts, communicating information in the form of news. But what will ambient media change? What if the smart media environment constantly personalizes, aggregates, and contextualizes the content of the me-

dia to specific consumer needs?

Let us consider the following principles, which are discussed in greater depth later in this article:

- Media aggregation rather than passive or weak interaction models.
- Media environments that are able to contextualize.
- Intelligent and engaging media.
- Assets, rather than products, services or communication, will be king.

2 The Basics of Ambient Media

This section looks at the very basics of ambient media and attempts to define its underlying terminology. The medium as such is the actual natural environment of the human. It may be a smart fridge, an intelligent car radio, or a smart phone collaborating with the consumer to perform shopping tasks, personalize and contextualize car radio music, or perform location based services.

2.1 Ambient Media Assets

The basic entity or object, or atomic unit we are dealing with in Ambient Media is the *ambient media asset*. An ambient media asset is the media object such as is suggested in the field of new media. However, ambient assets enrich the idea of products, services, or new media objects by considering the concept of consumption and collaboration with the media. As we have mentioned on many occasions, experience equals knowledge, and media assets blur the boundaries between the technology and the media conveying that knowledge. An asset can therefore be considered as "*useful or valuable thing [or] property owned by a person [...] regarded as having value*" [11]. Thus, neither "content is king" nor "content is not king" is correct. The future of the media industry involves more than the creation and consumption of content. The artefact that is delivered to the consumer is a "whole" comprising communication, content, services, and devices.

In the age of ambient media, we can therefore speak about ambient assets rather than single non-connected or communicating devices or content units. Each ambient media asset is applied at a product, resource, collaboration, and experience level in a specific use context.

Definition: Ambient media asset. An ambient media asset is an intangible or tangible experience-oriented entity consisting of an agglomeration of devices (or products), collaboration (human/human, human/device, device/device), resources (e.g. content) which are intelligently contextualized and aggregated to the needs of consumers in a specific situation.

2.2 Defining Ambient Media

At first sight, the definition of ambient media differs enormously from general definitions of media, which are related more to the communication of information. Ambient media communicate knowledge and experience to the consumer. Thus they are smart so as to be able to under-

stand the context and are capable of adapting to the specific needs of the consumer. The medium as such is the natural environment of the consumer acting as a surrounding substance via which knowledge and experience can be communicated. Another difference from more general definitions of media is that ambient media are collaborative rather than interactive. Interactive implies controlled feedback situations whereas ambient media assets act as "partners" or "assistants" to humans. Good examples of this are electronic toys or assistive technology for older people. Ambient media are not solely focused on entertainment technology or leisure purposes but are also capable of addressing real-life situations. Examples of this are intelligent cars that can recognize the distance between two cars and turn this information into knowledge by visualizing the danger to the driver in a contextualized manner.

Definition: Ambient media. Ambient media convey collaborative experiences in the natural environment surrounding humans either as a mode of artistic expression or of real-life communication under certain aesthetic rules.

2.3 Defining the Ambient Media Form

The ambient media form is concerned with how ambient media assets are physically embedded in the natural human environment. Factors arising from design and aesthetics are clearly applicable. If we look at smart homes, which are the living environment of humans, ambient lighting or product design are in the forefront. In ambient intelligent systems, the key idea is for complex technology such as remote controls, cables, monitors to fade into the background, while speech and gesture interfaces are used to collaborate with technology. The arrangement of a number of media objects, rather than individual media objects such as a single video stream, is what counts here, and therefore the way in which the experience is conveyed to the consumer changes.

The overall context of the consumer experience is what matters. The ambient medium adapts to the conditions of use of particular media objects and collaborates with the sum of all available media objects, products, and assets to provide this experience. In the case of the smart home, computer games are a good example. The home lighting system may be made to flash in response to actions taking place in computer games (e.g. amBX system from Philips [12]). For media designers it is obvious that existing rules and guidelines for the composition of the experience are changing.

Definition: Ambient media form. The ambient media form is the particular way in which ambient media assets physically exist or *manifest* themselves: the way they *morph* natural environment entities into a synthetic artificially created world, and collaborate, both with each other and with the *intelligence* of arrangements (composition) and the contextualization of media assets and their sub-components, as an artistic or factual genre for the creation of human *experience*.

2.4 Underlying Key Models and Concepts

Having outlined the basic definitions and the scope of ambient media, it is important to understand the basic underlying key models and concepts. This is especially important for ambient media designers, to enable them to establish guidelines for structuring the design of this new ambient media. The key models and concepts are listed below:

Ambient assets are the agglomeration of smart devices, services, and content, and convey consumer experience.

This agglomeration of smart devices, services, and content **is king**, rather than "content is king", "communication is king", or "products are king".

Narrative cube interlinking interaction, narration, and content (defined in [13] and further discussed in [14]).

World sphere model describing the relationship between human-centred aspects regarding the immersion of the human into the media (introduced in [2]).

Ambient space as the place or stage where humans, devices, content, and the natural environment co-exist.

Ambient media form as a new form of media, based on ubiquitous and pervasive technology with new underlying principles and characteristics.

3 Ambient Media Form

The form of the media, similar to film art [15] or the language of new media [16], deals with the aesthetics of embedding the synthetic (artificially) created universe into the natural environment of humans in time and space. The challenge is to base the ambient media form on other forms of media, such as visual media or print media, so as to have a coherent view of the style, aesthetics, and principles of this new form of media.

According to our definition of the ambient media form, the form of ambient media is concerned with issues of design, aesthetics, collaboration; the manifestation of media assets, the morphing of the synthetic universe/natural environment, collaboration, the arrangement of different content entities, etc. The main principles of the form of ambient media are:

- Morphing.
- Manifestation.
- Intelligence.
- Experience.

The last mentioned principle of ambient media, experience, will be explained in the section dealing with human-centred aspects of ambient media.

3.1 Morphing

In principle, morphing deals with connectivity on different levels, in other words, the connection of worlds. Primarily it concerns the relationship between real-world and synthetic world artefacts and maps the various entities. Many researchers use a metaphor for explaining complex technology in simple terms. This is an example of morphing. However, morphing also deals with collaboration between humans, human/device, or device/device. Morphing is how

the actual message of the medium to be conveyed is encoded and transmitted between entities and media assets. One good example of morphing is mediation. Mediation concerns the "*dialogue between a human and a computer that resolves ambiguity [... where ...] mediators [resolve] ambiguity caused by flaws*" [17]. Its primary purpose is to deliver the actual messages between the various entities involved in communication processes in an appropriate manner.

3.2 Manifestation

Manifestation is concerned with the stimulation of human senses by single media assets or the ambient spaces as such. It refers to how ambient media content is rendered in a humanly perceptible form, and therefore to the stimulation of human senses by ambient media transmitted via ambient content. Manifestation distributes the synthetic universe in time or space (or both) into the real world. A good example of manifestation are *tangible user interfaces* (TUIs) [18][19]. TUIs hide the computational model from the consumer, and the consumer interacts with real-world representations of the model in his or her natural environment. The connectivity component of how the two worlds are connected forms part of the principle of morphing. But the physical representation of objects and how the stimulation of human senses is performed is part of the principle of manifestation. Also issues arising from design, content creation, or physical creation of ambient technology form part of the principle of manifestation.

3.3 Intelligence

The principle of intelligence is concerned with the underlying computation model of an ambient media experience. For example, this may be the TUI underlying computational model, personalization algorithms, or the smart aggregation of media assets. This principle involves many aspects such as emotional models, experience models, situational models, aggregation models, and the underlying narrative model of how different arrangements of media objects are performed. As mentioned previously, in ambient media we are dealing with knowledge or experiences. Thus the main focus is on knowledge processing rather than on data or information processing. A good example of the principle of intelligence is the contextualization of media.

4 Human-centred Aspects in Designing Ambient Media

In designing ambient media, we have to consider the shifting borderline between the real-world, synthetic universe, and the world sphere of humans. The world sphere model, as presented in [2] sees the real world as the factual world. It is the "objective" world we are living in with its constraints in time and space. Within this world we are able to create new worlds, synthetic universes with their own time and space dimension. A good example is computer graphics – an artificially created world in the form of virtual realities becomes the temporary synthetic universe in

time and space for a human. Each human interprets the agglomeration of real world and synthetic universe in different ways. It becomes the world sphere consisting of the perception and interpretation of human sensory inputs.

With these arguments we are wandering more and more into the field of human centred aspects in the design of ambient media. As ambient media are smart media environments capable of contextualizing their form to the situation, we need to review and relate existing research coming from these fields.

With the arrival of ever more intelligent and interconnected systems, the human-centred aspects become more complex. Existing knowledge, such as the visual language components of film-making, can be adapted, but require a complete re-think. The key aspects of human-centred design of ambient media are:

- Interactivity.
- Sensor oriented systems.
- Experience orientation.
- Collaboration.
- Cultural aspects.
- Design for human aspects.
- Understanding human behaviour.
- Simulating human behaviour.
- A few of these aspects are discussed in the following section.

4.1 Understanding and Simulating Human Behaviour

One of the principles of ambient media is the understanding and simulation of human behaviour. For media acting as collaborating rather than passive input devices with simple feedback systems it is essential that a certain degree of intelligence is provided. The aim is to simulate human behaviour by the media as well as to contextualize the media as such to the human behaviour.

Such aspects include:

- Simulation of human behaviour by ambient media assets (e.g. electronic pets).
- Understanding human behaviour (e.g. to contextualize situations humans are in).
- Sociological models of human and society behaviour (e.g. to act as a mediator in collaboration work).
- Recognition of human emotions and modelling of emotions (e.g. to gain insight into the human mind and the experience level of the consumer).

A wide range of research fields are involved: cognitive science, activity theories, personality description, emotional research, etc. One example of the simulation of human behaviour is the Philips iCat, which is a toy capable of expressing human emotions [20].

4.2 Engagement as a Matter of Collaboration

Collaboration deals with the "actions of working with [something] to produce something" in a communicative way. In ambient media environments, collaboration extends from pure human/human collaboration to human/media asset and

technology-mediated collaboration. With increasingly intelligent systems, collaboration redefines the relationship between the technological world and the human world. The trends towards increasingly computerized environments requires a substantial adaptation of sociological, psychological, and collaborative models to support a collaboration rather than a simple interaction with technology. We all know how annoying existing digital assistants can be, such as those used in call centres: "... if you would like to speak to department X, please press 2 on your phone...". In an ambient media environment, collaboration will be used to achieve a common goal, rather than simple feedback systems with dial-in numbers.

This will change our view of interactivity. Interactivity as such is a rather complex topic and is relevant to a great many fields, especially the broad field of new media. Interactivity has become a must, and non-interactive systems have been discarded as old-fashioned and inappropriate to the age of the Web and computer games. For ambient media, the key is the development of collaborative concepts rather than simple interaction strategies.

4.3 Human Experiences and Emotions as the Focus of Attention

As we are dealing with media assets in the world of ambient media, it is important to understand that we are living in an experience industry. Rather than the industry focusing on the physical product, it needs to develop an agglomeration of 'something' which is memorable and personal, and build a story around and inside the actual product [21][22]. Experience-driven media environments such as ambient media are also closely linked to human emotions. Emotions, either positive or negative, transform the knowledge of the events that humans are experiencing into knowledge.

Filmmakers create an experience for their audience by using a well-established visual language in their work. They select actors, colours on the set, etc. to create an artificial story world for the consumer. The consumer's experience is to be immersed in a completely new fictional universe. Human-centred design aspects relate mostly to the knowledge of how to tell an exciting story using existing film technology.

In the case of ambient media we are confronted with a far more complex task than simply designing a set for a film. When a production designer designs the set for a motion picture, he is aware of the impact of colours on humans. Red has a more aggressive meaning, and evokes tension. However, it can also evoke love or a passionate moment of the main actor. When focusing on ambient media, human-centred aspects are far more complex and today there is no such thing as ambient media language, the equivalent to visual language in motion pictures.

5 Discussion

Ambient Media today is still in its infancy. Most of the underlying principles and characteristics are unknown. One

aspect is the distributed stimulation of human senses and the effects which this degree of distribution will have on the human. Tiny sensor networks will be capable of stimulating and sensing the activities and emotions of humans and act as an input device for the media environment of the future. Media aggregation will become a matter of system. Nowadays media aggregation – or the arrangement of media objects as a whole – is in the hands of broadcasters, newspaper editors, or film-makers. In ambient environments, aggregation becomes a task for the machine. Search engines such as Google are just the first step towards advanced aggregation. The next step will be personal products distributed via mobile phones able to communicate with the natural environment. One scenario could be advertising screens in shops, capable of reading potential customers' personal profiles from their phone and personalizing the advertising to their desires. For further reading about this scenario readers are referred to [23].

Other cultural or aesthetic aspects are also changing. Professionally created content still promises the greatest revenues, but lower quality content is rapidly emerging in the media environment. Like many broadcasters, CNN allows private individuals to submit news videos. This is an example of the trend towards a collaborative knowledge pool – more technically-oriented people might speak of a distributed intelligent sensor network contributing to the actual content.

What happens if the natural environment becomes the place for media experiences? Does this involve turning the natural environment into a theatrical stage? Where will future levels of realism lead us? It is a fact that certain applications or services still require the control mechanisms which we know today as simple interactivity. However, the trend is towards a more interconnected media landscape, where more and more consumer products are capable of exchanging information with one other via open interfaces. This also involves the need for models that help creators implement their meta-story or meta-experience across a wide range of different platforms.

And what might the media environment of the future look like? What happens if bio-technology and existing medical technology is used to create a new synthetic universe? The future will show whether visions of Hollywood are to become reality one day (see [2] for further reading).

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