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## A Market Overview on Presence Technologies and Applications

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### Abstract

*This paper focuses on an extensive market analysis done under the framework of the Peach coordination action, a project funded by the European Union Future Emerging Technologies unit. The analysis identifies, classifies, reports and further elaborates on which areas presently benefit from Presence technologies. Taxonomy of these markets is also derived in this document, describing how and why Presence is used there. Finally some data are extrapolated, showing which are the most addressed markets and which Presence technologies are the most exploited. The presented results are based on an extensive search performed on companies that have currently adopted or are producing Presence solutions. The identification of these companies is based on the support of the Peach Presence research community, and general media.*

**Keywords---** Presence, Social Presence, Market, Industry, Company, Application, Technology

### 1. Introduction

Presence<sup>23</sup> has been researched for years in universities and government labs, but because of the enormous computing power demands and associated high costs, applications have been slow to migrate from the research world to industrial areas. Nevertheless, technical issues and costs are not the main issues: the key question is making the technology suitable for real-life uses. Continual improvements in the price/performance ratio of related devices, however, have made Presence technology more affordable, and thus, many applications of Presence are reported in papers and the media not only on experimental level but also on industrial level.

By nature a deeply interdisciplinary field, Presence spans a wide range of subjects: from neuroscience and cognition to

artificial intelligence, sensors and systems. This horizontal character makes Presence a fascinating and fertile interdisciplinary field, but it is can also stunt its growth, as researchers are scattered across disciplines and groups worldwide. A three-year long coordination activity, started in May 2006, promoting discipline connect, identity building and integration while defining future research and policy directions has thus been promoted under the framework of Peach [1], a project funded by the European Union Future Emerging Technologies unit. The first goal of Peach is to stimulate, structure and support the research community, with special attention to the challenges associated to the interdisciplinary character of the field, and to produce visions and roadmaps to support the construction of the Presence. Secondly, because Presence research is set to produce disruptive technologies which can cause profound social impact and raise serious ethical issues, Peach will analyze the relation of Presence technologies with society (trends, ethics, legal aspects), foster the contact of researchers with the market and enhance the public understanding of Presence research and technology.

In this paper we present an overview of the application areas of Presence which can be found in the market. Nonetheless, this research does not constitute an exhaustive list in any given area, but rather is designed to highlight interesting, representative products and services.

### 2. Methodology

Two activities done in parallel are the core of this analysis. First, a Presence companies' database was produced by actively searching in the industry (on-line media, and Peach Presence community) from April 2007 to April 2008. Second, the industrial application areas of Presence were categorized, as the result of the former one.

The companies were logged in a Presence company list [2] and a questionnaire was sent out to the companies. The questionnaire was aimed at collecting data describing the company activity on Presence; the following information was asked:

<sup>23</sup> In the present work we are not referring to Presence as online Internet technologies, especially developed with Instant Messaging application (see for instance documentation by IETF [www.ietf.org](http://www.ietf.org)), neither to their evolution to mobile applications (see for instance documentation by OMA [www.openmobilealliance.org](http://www.openmobilealliance.org)).

- brief company description
- brief products and services description
- company contact details
- size of the company (small, medium or large enterprise)
- multiple-choice applicable area of competence (e.g. acoustic interfaces, artificial intelligence, signal processing, etc.)
- multiple-choice applicable area of application (e.g. telecommunications, medical, entertainment etc.)
- nature of interest in Presence (e.g. producing Presence technologies, using it to enhance company's product/service, relying on Presence feelings of company's final users).

However, and for different reasons, not all the companies provided feedback. In these cases, we filled in the questionnaire based on the research of the companies' profiles and websites. As a way to stimulate the reaction and participation, we also published the company list timely on Peach website, <http://peachbit.org> [1], inviting the companies to contact us at any moment in order to review and update the published information.

The category of the application area structures the questionnaire whilst the result of the company list sometimes led to the change and adjustment of the taxonomy.

In addition, the Presence company list also provides the raw data for statistically analysis of the market characteristics, country distribution and competence distribution, just to name some examples.

Source	Authors' initial list	ISPR list	IST2006 contacts	Peach who is who 2006	Web search	Total
Accepted	11	2	15	3	91	122
Rejected	2	37	9	4	7	59
Total reviewed	13	39	24	7	98	181

**Table 7 Major sources and review statistics for the Presence Company database**

Table 7 summarizes the major sources of information and the review process statistics for the Presence Company database. The initial ideas for companies to be included in the database came from authors' knowledge, from a list compiled by ISPR (International Society for Presence Research) [3], which supports academic research related to the concept of (tele)presence, from the "who-is-who" data collection activity of the Peach consortium [4], which is a Peach edited open list of researchers and experts on Presence, as well as from contacts established during the networking session on Presence organized by Peach in Helsinki within the European community supported IST 2006 Event [5], where a number of

business cards were collected and later analyzed. Later, web-based search was more focused and based on identified application areas and technologies, as well as some further personal contacts and information from other sources. Based on the review of a total of 181 companies from all mentioned sources, 122 companies were retained in the current database.

Last but not the least, it is worth to mention that this activity is still in progress and modifications of the methodology may be possible in the future, which will result in updating these results accordingly.

## 2. Markets for Presence

### 2.1 Presence technologies

Presence is a field studying the science, technology and social impact of digitally mediated interaction. It consists of research strands studying how to produce "real"-feeling experiences and the impact of new interaction technologies on social networks.

Presence Science [3] studies how the human brain constructs the model of reality and self using replacement/augmentation of sensorial data and interaction. Presence Science belongs to a wider class of research fields studying how cognitive systems build models of their environment and interact with it.

The main goal of the field is to develop science and technology to achieve successful replacement/interaction (i.e., Presence, being someone, there, with others) and open up a wide range of powerful applications.

We can separate the Presence research field in the following three main areas:

- **Human/Social cognition:** This is considered in a broad sense, including both intelligence and action, as well as emotion and volitional processes. In terms of disciplines, this spans cognitive psychology and cognitive neurosciences, social sciences, psychology of emotions, as well as cognitive anthropology and linguistics.
- **Human-machine interfaces:** technologies to send and receive information from the human(s) to the machine agent(s). These are basically human-machine bi-directional communication gateways: displays, cameras, microphones, speakers, electrophysiological sensors, vestibular or other stimulation, odour synthesis, transcranial magnetic stimulation etc.
- **Machine cognition:** this field involves artificial intelligence (in the widest possible sense), computational intelligence (including fuzzy logic, statistical learning, etc.), as well as large data system management, automatic classification, statistical analysis and signal processing. This aspect is perhaps less relevant in the technology mediated human-human communication scenario, but becomes critical

in machine-human interaction, providing the essential “ghost in the machine”.

Among the enabling technologies of Presence, perhaps the most important one is human-machine interface. Human and machine agents each have actuators and sensors, and they are allowed for direct interfaces as well.

A non-exhaustive list of enabling technologies which are relevant to Presence have been taken in account in searching and selecting the Presence company list. These technologies can be associated to the following main competence areas:

- Acoustic Interfaces
- Brain - computer interfaces
- Artificial intelligence
- Augmented/mixed reality
- Computer graphics
- Communication technologies
- Computer vision
- Human - computer interaction
- Haptic interfaces
- Medical imagery & measurement
- Signal processing
- Virtual reality
- Virtual humans

## 2.2 Presence application areas

Analyzing the Presence company list we derive a taxonomy which identifies eight application areas where those companies are running a business exploiting Presence technologies, and that we call here markets. The identified markets are:

- Medicine
- Entertainment
- Training and education
- Telecommunications
- Military
- Marketing
- Manufacturing and Design
- Architecture and construction

In the following sections we describe, for each market, which are the main advantages that Presence brings to the activities performed by the companies active in the corresponding application area.

### 2.3 Medicine

This is one of the most well-known markets for Presence, as results from the analysis of the company database analyzed in this paper, where it scored the highest company’s target number. Medicine benefits from Presence in several ways. Through augmented visualization it helps to expand the

information available to the surgeon while operating on the patients [7]. Using immersive environments enables to treat phobias and other mental problems by taking the patient into a therapist controlled virtual experience [8]. Using simulations or representations of individuals involved in one or more healthcare processes, it offers surgeons the chance to practice skills, techniques and critical tasks in a real-life context but in a risk-free and cost-effective way [9].

### 2.4 Entertainment

This is the second main application field for Presence. Entertainment benefits from Presence in changing the way we watch movies, making them interactive and immersive and enabling to meet fantasy characters within a simulated environment. Another advantage played by Presence technologies here is to enable people to interact with game context and act as if they were really in the games. Finally and recently quite a hype, people have begun to entertain themselves via computer-based simulated environments intended for its users to inhabit and interact via avatars, i.e. Second Life and similar virtual worlds: every day millions of users visit those virtual worlds that exist as games/role play/fantasy worlds..

### 2.5 Training and education

This area appears from the included companies analyses to be nearly as much targeted as entertainment. Here Presence is used to develop highly immersive learning tools (such as simulation, virtual reality interfaces and role playing) which enable trainees to do just what with a real experience is hard to manage and ‘create’; moreover it can be exploited in education for visualizing abstract (but not only) concepts.

### 2.6 Telecommunications

A very well known example of immersive environment, which is video-teleconferencing or tele-presence is a typical example of how Presence helps to recreate the illusion of communicating as being in the same place. Another advantage delivered by Presence is to recreate and augment the social experience of communicating and collaborating with someone else: this brings advantages to applications in the mediated collaboration field, supporting work teams or managing shared knowledge. Telecommunications can also benefit from Social Presence [7] [11] [12] which can add non-verbal cues [13] [14] emotions and contextual information to the standard mediated communications: this ends in developing virtual interactants or agents<sup>24</sup> [15], which have some level of artificial social intelligence in dealing with real humans.

<sup>24</sup> Not to be confused with avatars, which are virtual representations of real people. Agents are independent, artificial entities.

## 2.7 Military

This area focuses on the competitive advantages which especially come in augmenting human capabilities. Adopting displays enhanced with augmented reality systems helps to provide extra information to the soldiers. Moreover military forces exploit simulation-based training in the operation of various weapons and vehicles, and apply virtual environment and video-game technology to tactical training tasks and recruitment [16].

## 2.8 Marketing

Marketing can benefit in several ways from Presence: visualization, virtualization, augmentation. A product can be shown via a 360-degree 3D animation even if not there. Customers can try clothes and other apparels in virtual showrooms, enabling customers to experience the products and customize for their own preferences. Advertisers can tailor ads to a specific context using virtuality. Finally virtual worlds can be a place where real people's avatars go and see real (or virtual) products and brands, and buy them in the virtual world or real one with virtual money that eventually turns to be real.

## 2.9 Manufacturing and design

Presence here is mainly applied to achieve the best visualization. Using virtual reality is a key to create 'virtual prototypes', or demonstrating design work (e.g. organizing a virtual fashion parade), or leveraging on virtual ergonomics to improve workplace safety and efficiency. Visualizing complex data, e.g. oil reservoirs deep in the ground, is also another effective way to keep industrial costs low [17].

## 2.10 Architecture and construction

This is another area where visualization and "immersiveness" are the main benefits coming from Presence. One application, the architectural walkthrough, is a computer-based, interactive system that can simulate the visual experience of moving through a 3D model, e.g. helping to see the impact of proposed urban designs [18]. Another is the 4D production modelling, which allows to view a planned construction over time on the screen and to review the planned or actual status of a project.

## 3. Presence Exploited Features

Analyzing how the previous markets benefit from Presence, it is possible to isolate four main features, that are extensively used:

- **augmented/3D visualization**, that impacts mainly on surgery, entertainment, military, marketing, manufacturing and design, architecture and construction, education. This feature relates to the

capability of showing reality in a more effective way, adding useful information and cues or just allowing to visualize the "invisible";

- **immersive environments**, that impact mainly on medical virtual therapy, training, virtual worlds, mediated communications. This feature fully recreates the sense of being in a place, alone or with someone else;
- **haptics applications**, that impact mainly on medical simulations, interactive games, robotics (tele-operation e.g. in surgery). This feature extends the perception of virtuality beyond visualization embracing the sense of touch or the sense of being operating physically on something virtual (force feedback);
- **social presence**, that impacts mainly on telecommunications (and more specifically to mediated communications, collaboration systems, and virtual humans), and robotics. This feature deals with the sense of being with someone else, making easy and natural to communicate as in a face-to-face situation, collaborating with someone else, and even having a better and effectively understanding of a group dynamics, finally helping to give to virtual humans and robots a human behavioural flavour

## 4. Market Analysis

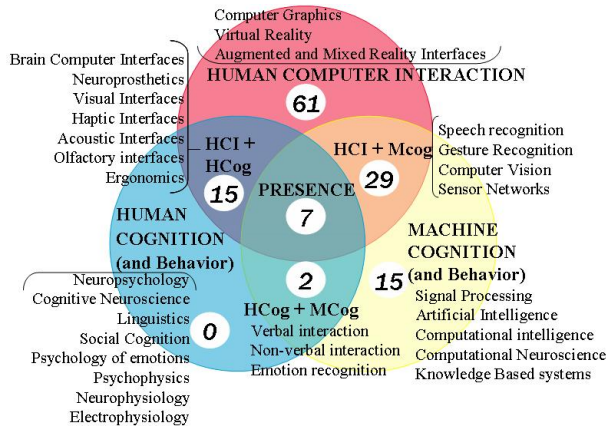
We analyzed 122 companies that have been identified as either offering Presence technologies or using them in their products/services [1]. We have analyzed the data base with respect to the companies' areas of competence, markets and geographical location.

Competence Area	Companies
Acoustic Interfaces	2
Brain - computer interfaces	7
Artificial intelligence	1
Augmented/mixed reality	6
Computer graphics	25
Communication technologies	12
Computer vision	11
Human - computer interaction	13
Haptic interfaces	10
Medical imagery & measurement	19
Signal processing	6
Virtual reality	53
Virtual humans	7

**Table 8 Distribution of Presence-related companies by areas of competence**

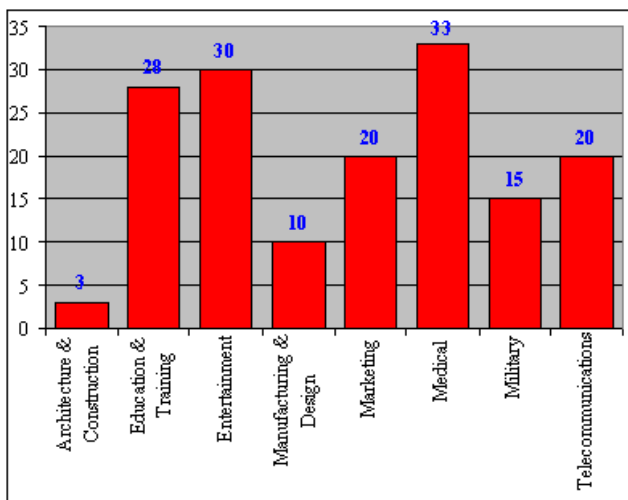
The distribution of companies with respect to their areas of competence is presented in Table 8. The dominance of virtual reality and computer graphics is the result of traditional view of

these technologies as central for achieving presence, but to some extent also due to the fact that these companies were the best known to the researchers; it is therefore expected that with ongoing efforts in filling the data base the disproportion will become somewhat less pronounced, though most probably virtual reality will still dominate.



**Figure 25 Distribution of Presence-related companies within the three pillars of Presence**

Based on the distribution of companies by areas of competence, the companies were placed within the three pillars of Presence as identified by the Peach community [6] (Figure 25; the numbers in white circles show the number of companies in each area). Due to a large number of companies with competences in computer graphics and virtual reality, the human computer interaction field is the most populated. A lack of industrial activity in the human cognition field may be noted.

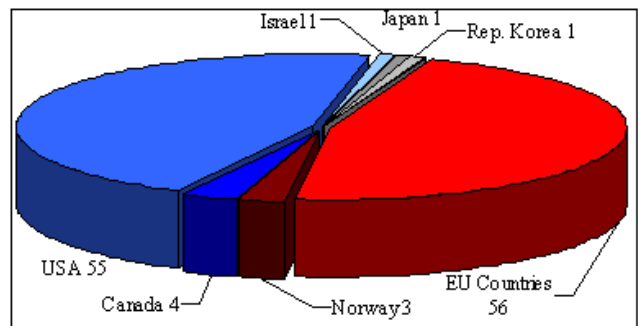


**Figure 26 Distribution of Presence-related companies by market**

The distribution of companies with respect to the markets in which they are active is presented in Figure 26. We can note

medical, entertainment and education/training as currently most active markets in terms of number of companies engaging in them (we have no means to evaluate the actual volume of these markets in terms of revenue).

The geographical distribution of companies is presented in Figure 27. The largest number of companies in a single country is found in the United States. However, the total number of companies in Europe is slightly higher than in the US. Outside the United States and Europe, we have identified companies in Norway, Israel, Canada, Korea and Japan.



**Figure 27 Distribution of Presence-related companies by geographic areas**

### Conclusions

We performed an active analysis of the industry, searching for companies which have currently adopted or are producing solutions exploiting Presence technologies or applications. We identified 122 companies, which can be classified as active in eight markets or application areas. The most populated market is medicine, followed by entertainment and education & training. Most of the companies show a competence in human computer interaction technologies, like computer graphics, virtual reality, augmented and mixed reality. Aside from virtual reality, which is the most produced and used “technology” in the Presence markets, many companies are playing a role on computer graphics, that of course is central in 3D visualization and immersive environment rendering. Similarly, medical imagery is also a very well spread technology. Our database of companies could not identify companies with a competence on human cognition, suggesting perhaps that this is field is more an academic or laboratory one. We also found out that the Industry is roughly geographically divided between North America and Europe. We intend to keep working on this activity so that these results will be updated in the near future.

### Acknowledgments

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