

MARKET ANALYSIS OF PRESENCE TECHNOLOGIES AND APPLICATIONS: AN UPDATE

Gianluca Zaffiro

*Telecom Italia S.p.A., Research & Trends Department
Via G. Reiss Romoli 274, 10148 Turin (Italy)*

Giulio Ruffini

*Starlab S.L. - Research Department
Camí de l'Observatori Fabra s/n, 08035 Barcelona (Spain)*

Cristina Martin-Puig

*Starlab S.L. - Research Department
Camí de l'Observatori Fabra s/n, 08035 Barcelona (Spain)*

Igor S. Pandzic

*University of Zagreb Faculty of Electrical Engineering and Computing
Unska 3, 10000 Zagreb (Croatia)*

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, and constitutes an update to previously released works. Some future applications for Presence are also proposed as the result of some panel activities in the Presence research community.

KEYWORDS

Presence, social presence, market, industry, application, technology.

1. INTRODUCTION

Presence¹ 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

¹ 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), neither to their evolution to mobile applications (see for instance documentation by OMA www.openmobilealliance.org).

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 Peach², 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 November 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 [I. Pandzic, G. Zaffiro, 2008] 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:

- 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 [I. Pandzic, 2008], 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.

Table 1: Major sources and review statistics for the Presence Company database (updated Nov 2008)

Source	Authors' list	ISPR list	IST2006 contacts	Peach 2006 who is who	Web search	Total
Accepted	34	2	15	3	91	145
Rejected	2	37	9	4	7	59
Total reviewed	35	39	24	7	98	203

² Peach FP6 Coordination Action No 33909. URL <http://peachbit.org> [last access Nov 2008]

Table 1 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 [C. Martin-Puig, 2006], 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 [S. Dunne, 2006], 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 203 companies from all mentioned sources, 145 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. This paper, compared to previously released one [G. Zaffiro et al., 2008] is including an extension to the company list, which extends to November 2008, increasing the number of companies analyzed and slightly changing some results.

3. MARKETS FOR PRESENCE

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 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:

³ ISPR URL <http://www.temple.edu/ispr> [last access Nov 2008]

- 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

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:

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

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.

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 [J. White, 2002] . Another is the 4D production modeling, which allows to view a planned construction over time on the screen and to review the planned or actual status of a project.

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.

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 [C. Lin, R. B. Loffin, T. Stark, 1998].

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.

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 [K. Kania, 2000] . Using immersive environments enables to treat phobias and other mental problems by taking the patient into a therapist controlled virtual experience. 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 way⁴.

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 [J. White, 2005] .

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 [F. Biocca, C. Harms, J. Gregg, 2001, J. Hauberet al., 2005, G. Riva, R. Schroeder, G. Zaffiro, 2008] which can add non-verbal cues [F. Martino et al., 2007, M. C. Brugnoli et al., 2006] emotions and contextual information to the standard mediated communications: this ends in developing virtual interactants or agents [M. Garau, 2003], which have some level of artificial social intelligence in dealing with real humans.

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.

⁴ See for instance the Medicine Meets Virtual Reality conferences www.nextmed.com/mmvr_proceedings.html [last access Nov 2008]

4. FUTURE APPLICATIONS FOR PRESENCE

In this section we explore future applications for Presence technologies. The method we used was to interview a panel of experts in the Presence field.

Peach is organizing several events where the Presence community, composed by experts in this area, are involved. In the last couple of years two Summer Schools and one Industry Event have taken place. During the Summer School 2 in Dubrovnik, 9-11 July 2008⁵ and the Industry Event in Torino, 12-13 November 2008⁶, Peach proposed an interactive session where delegates were asked to discuss and envision future applications for Presence.

Proposals were added on nine posters hanged up in a meeting room. Each poster was entitled to a different market area, except one left to “other applications”. Members of the core team moderated the session and stimulated the contributions.

We gathered a total of 162 ideas. Most of them (19%) appeared in the “other applications” poster, followed by “entertainment” (16%) and “medicine” (13%). The less addressed area was telecommunications (6%). In the following paragraphs we are summarizing some results.

Architecture and construction

Most suggestions are in line with the currently existing applications to visualize architecture, to do virtual design, to predict of future urban shifts (including simulation of demolitions).

Interesting proposals are:

- to see installations in the walls (tubes, cables);
- to make “my tiny house look like a castle”.

Entertainment

Most proposals to use Presence insist on virtually meeting celebrities (alive or not...) and to simulate human activities in the entertaining area (like games, sports, arts etc) in order to allow practicing them before playing in reality; these proposals are in fact belonging the training area.

Interesting proposals were:

- to induce organic stimuli (like thirstiness, hungriness etc);
- to create virtual hallucinations (without any chemical substances), which might give rise to strong ethical issues;
- to generate emotionally-compelling activities which are not mimicking reality (situations that you can't create in reality).

Manufacturing and Design

In general panelists suggest to use Presence technologies to visualise prototypes and complex data, and virtually plan industrial plants.

Two proposals differ from the mainstream:

- to apply Presence to the 3D reconstruction of products using ultrasonic sensors;
- to model or predict unexpected uses of products (or services).

Marketing

Proposals for Marketing are about using Presence technologies to visualize virtual products and create interactive advertising.

Some more creative proposals are:

- to create video billboards with avatars that show emotions according to what they are advertising;

⁵ The Peach Summer School 2, 9-11 July 2008, Dubrovnik (Croatia) <http://school.peachbit.org> [last access Nov 2008]

⁶ The Peach Industry Event, 12-13 November 2008, Torino (Italy) <http://industry.peachbit.org> [last access Nov 2008]

- to transport personal characteristics (e.g. Facebook.com photo) to target advertising in order to achieve sympathy (e.g. see Bailenson's TSI - Transformed Social Interaction - theory in P. Messaris et al., 2006, pages 255-259);
- to generate a virtual salesman with psychological feedback.

Medicine

In general suggestions indicate that Presence can be used in order to train medical personnel by simulating internal organs or the entire patient body and recreating virtual medical tools; other suggestions were to augment information to support treatments and procedures, and to use virtual treatments. These ideas are in fact already existing applications.

Disruptive proposals were:

- to generate virtual symptoms in order to discourage certain habits;
- to support virtual (self) hypnosis;
- to host a live brain in a virtual body if the real one is not alive anymore.

Military

Most suggestions are in line with the currently existing applications to simulate various phases of the war, to augment information to the soldiers, and to train to use vehicles, weapons, to perform tasks etc.

Interesting proposals are:

- to create pre-traumatic (instead of post) stress disorder simulators (giving trainees the worst aspects of war before they get there for real)
- to simulate the post-battlefield and see what happens to the place and the people after
- to adopt psychological torture techniques for interrogation of prisoners of war.

Telecommunications

Presence has been proposed as the mean to be there together, cooperate, regardless of doing this between humans or virtual agents.

Some proposals indicate the (ever and ever) growing interest in generating and transporting emotions in communications. This will let us feel emotionally co-present with someone remote (especially beloved ones), or give back emotional feedback to the actors / performers during live event broadcasted to remote audience.

Training and education

Quite obviously Presence can be used to learn and practice how to operate tools, vehicles, perform or rehabilitate to perform tasks, playing roles.

An interesting proposal is to leverage on virtual training to let people think and understand about the consequences of their own actions (e.g. bad habits and behaviors).

Other application areas

The following suggestions are not strictly applicable to the other market areas. Here are some of the (disruptive and sometimes even "bizarre") proposals:

- Enabling asynchronous collaboration
- Using Presence technologies to investigate our brains' capabilities (see also preface by Biocca, page vi, in G. Riva et al, 2003) e.g. as "cyclotrons for the brain"
- Developing virtual space travels / time travels
- Gene swapping and seeing what your babies are going to look like
- Virtual cloning
- Experiencing new physics, new bodies

- Feeling present with people who are no longer there
- Exploring and “representing” paranormal experiences

5. PRESENCE EXPLOITED FEATURES

Analyzing how the previous markets benefit from Presence, it is possible to isolate four main features, which 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

6. MARKET ANALYSIS

We analyzed 145 companies that have been identified as either offering Presence technologies or using them in their products/services. We have analyzed the data base with respect to the companies' areas of competence, markets and geographical location.

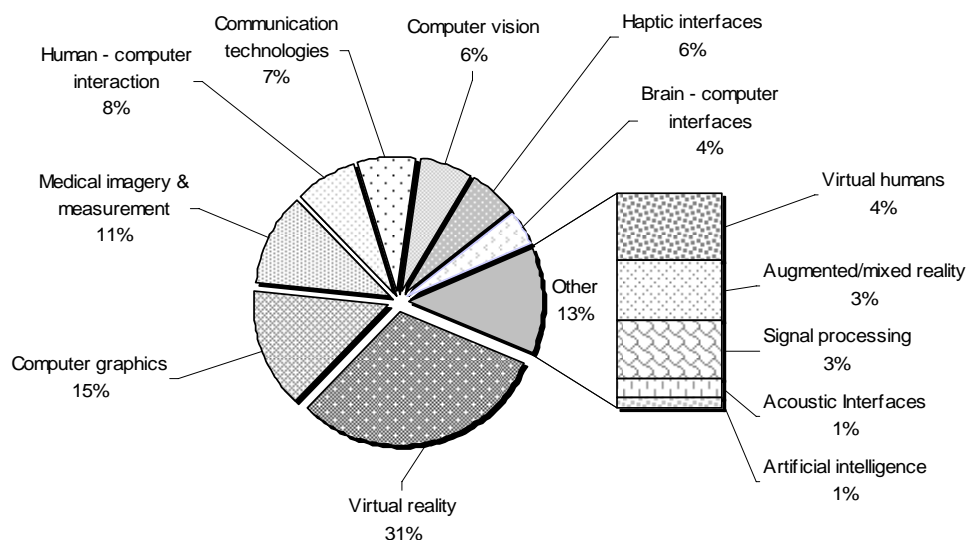


Figure 1: Distribution of Presence-related companies by areas of competence

The distribution of companies with respect to their areas of competence is presented in Figure 1. 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.

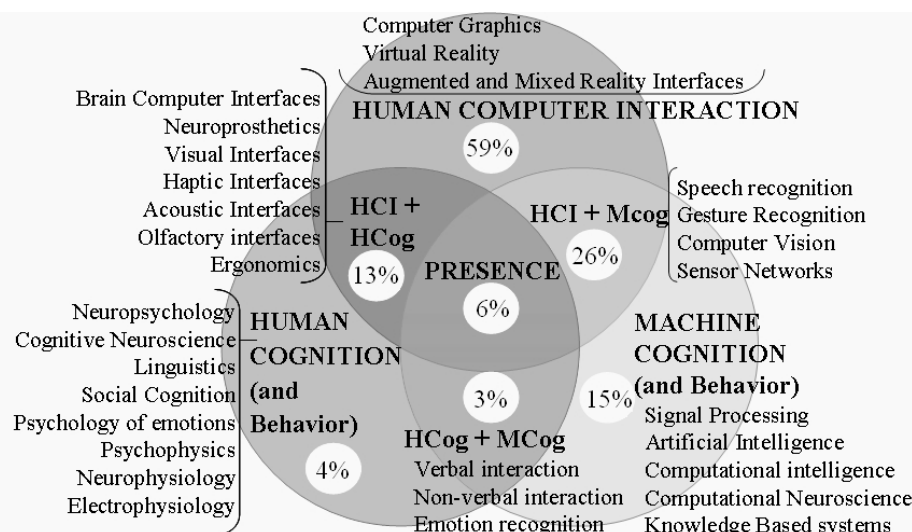


Figure 2: Distribution of Presence-related companies within the three pillars of Presence

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 [G. Ruffini et al., 2006] (Figure 2; the numbers in white circles show the percentage 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 low industrial activity may be noted in the human cognition field and its intersection with the machine cognition.

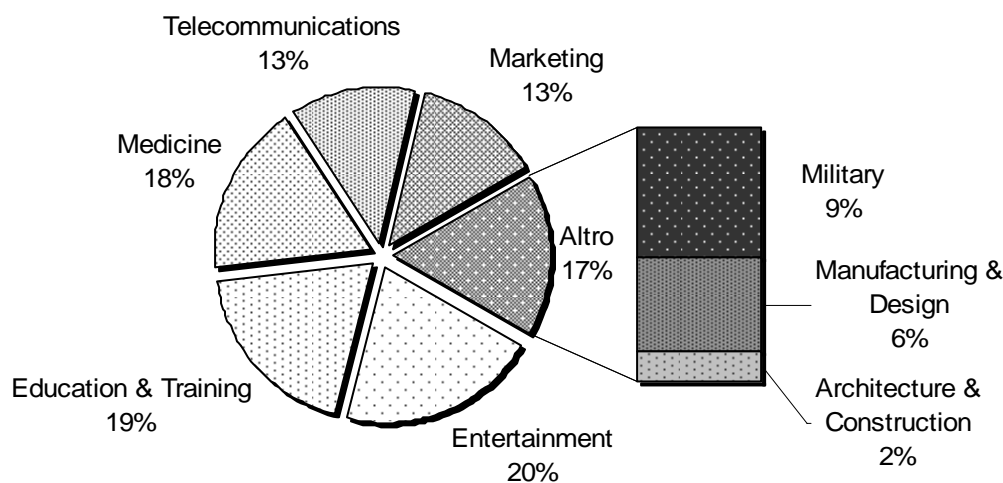


Figure 3: Distribution of Presence-related companies by market

The distribution of companies with respect to the markets in which they are active is presented in Figure 3. We can note entertainment, education/training and medicine 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 4. The largest number of companies in a single country is found in the United States. However, nearly half number of companies can be found in North America and Europe.

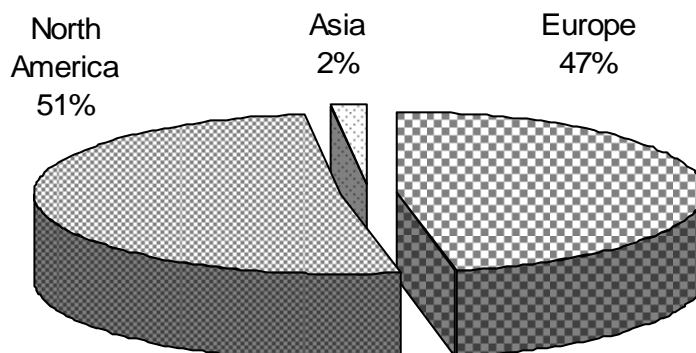


Figure 3: Distribution of Presence-related companies by geographic areas

7. CONCLUSION

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 so far 145 companies, which can be classified as active in eight markets or application areas. As part of this research we conducted two panel activities to explore the future applications for Presence in the identified markets, leaving experts free to add proposals also in unidentified areas. Results were mainly confirming the current applications, while some disruptive proposals are addressing experiences that do not have a counterpart in real life. The most populated market today 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 that will benefit from advanced visualization techniques. Our database of companies identified only a few companies with a competence on human cognition, suggesting perhaps that this is field is today more an academic or laboratory one. We also found out that the Industry is roughly geographically divided between North America and Europe. Finally, we intend to keep working on this activity and these results will be updated in the near future.

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