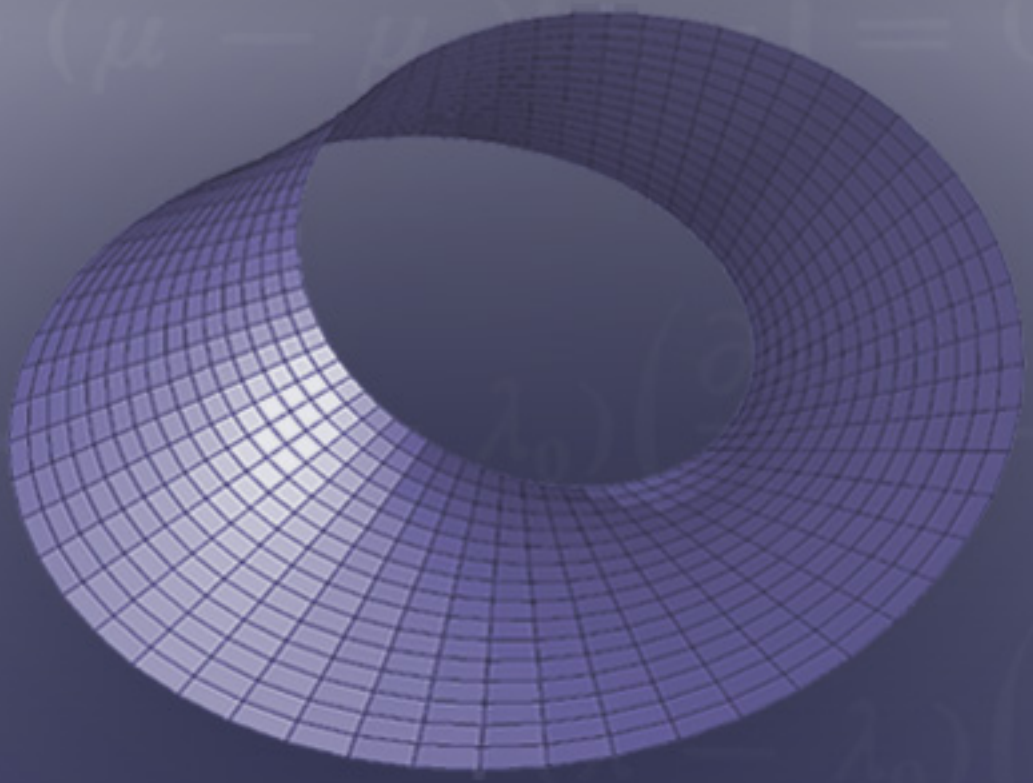
# The emergence of new types of hybrid mobile communication environments and their impact on social life within the urban context



# The emergence of new types of hybrid mobile communication environments and their impact on social life within the urban context

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*This paper aims at investigating the emergence of new forms of communication environments supported by the integration of new mobile and locative media technologies and the impact that the implementation of these systems may have on mediated communication within the urban context. The paper focuses on such systems accessed via mainly 3D interfaces and supported by different output devices (mobile phone screen, augmented reality HMDs etc.), which may ultimately afford a hybrid (synthetic & physical) spatial experience and a novel form of social interaction. Cities, as complex systems and contexts supporting communication are being re-ordered by technological systems and networks. Advances in mobile and wireless communication technologies (new mobile devices, GPS enabled phones etc.) and a series of location-based activities (games, socialising services, commercial applications and artworks) have begun to transform the potential for social relations taking place within the urban public space, as well as our perception of public spaces in general. Firstly the paper discusses the technologies supporting such systems: interactive 3D graphics interfaces for mobile devices, locative media, augmented reality interfaces. Then, the paper investigates the experience of interacting with such systems from a user's perspective. Finally, the impact of utilizing these systems for supporting interpersonal mediated communication within the urban context is discussed. Consequently, these emerging types of communication may lead to a new kind of agora, involving new forms of civic, cultural and political participation. Of particular interest to this paper is the manner in which the spatial context, where "situated" communication occurs, is transformed by the introduction of these technologies. The emergence of locative-ness re-introduces the parameter of real location within the communication activity thus mapping the "virtual" mental space of communication to the physical space where the real bodies of communicating participants exist. Another important parameter taken into account in the paper is the actual interface through which each participant experiences the process.*

## 1. Introduction

This paper aims at investigating the emergence of new forms of communication environments supported by the integration of new mobile and locative media technologies and the impact that the implementation of these

systems may have on mediated communication within the urban context. The paper focuses on such systems accessed via mainly 3D interfaces and supported by different output devices (mobile phone screen, augmented reality HMDs etc.), which may ultimately afford a hybrid (synthetic & physical) spatial experience and a novel form of social interaction.

Cities, as complex systems and contexts supporting communication are being re-ordered by technological systems and networks. Advances in mobile and wireless communication technologies (new mobile devices, GPS[1] enabled phones etc.) and a series of location-based activities (games, socialising services, commercial applications and artworks) have begun to transform the potential for social relations taking place within the urban public space, as well as our perception of public spaces in general.

The paper discusses the technologies supporting such systems: interactive 3D graphics interfaces for mobile devices, mixed or augmented reality interfaces and locative media. It also investigates the experience of interacting with such systems from a user's perspective. Finally, the impact of utilizing these systems for supporting interpersonal mediated communication within the urban context is discussed. Consequently, these emerging types of communication may lead to a new kind of agora, involving new forms of civic, cultural and political participation.

## 2. Interactive 3D Human-Computer Interfaces

In this section of the paper, virtual environments (VEs) will be discussed as a form of human-computer interface with the aim of identifying the essence of experiencing such an interface from the viewpoint of the user.

### 2.1 Virtual reality and virtual environments

Virtual reality (VR) is the convergence of a series of technologies[2] that supports a real-time interactive relation between a user of a computer system and three dimensional computer graphics environments, via visual, auditory and tactile sensory modalities (Meimaris, 1997: 1). *Virtual Environments* (VEs) are the synthetic environments, the generation of which is supported by VR technology and which enable a user to interact with a computer system in a multisensory and intuitive manner.

VE systems are therefore a very advanced form of human-computer interface and their significance is due to the fact that they enable a user to communicate with a computer via activities, movements, manipulations and assessments similar to the ones he usually does in real life and not via activities that he has to learn how to execute.[3] During their lives, humans develop certain skills for acting upon objects of the real world, for moving within this world and for understanding what happens in there. VE systems are actually built on the basis of these human abilities and utilize them for making human-computer communication an easier, more efficient and intuitive process.



### 2.2 Virtual reality as a communication medium and the experience of "telepresence"

Before discussing the social dimensions of VR systems, this paper briefly refers to their communicative function from a single-user perspective and investigates the experience perceived by a user of a VE during interaction with the system. Several researchers in the field of computer simulation have so far emphasized the role of *VR* as a *communication technology* or a *medium of communication*. Ellis (1991) described virtual environments as «media of communication», while Biocca & Levy (1995: 9) noted that VR could be the next dominant medium if not the ultimate medium. The concept of «information» is mostly used to denote *what* is transferred to a *single individual*, rather than what is exchanged between two or more individuals. Therefore, single-user VR may be defined more accurately as an information technology, rather than a communication technology (Schroeder, 1996). However, there is an important difference between VR and other information technologies: VR provides a navigable and manipulable space within which communication takes place (Biocca & Levy, 1995; Palmer, 1995; Schroeder, 1996). Biocca & Delaney (1995) defined a communication interface as the interaction of physical media, codes and information with the user's sensori-motor and perceptual systems. In this sense, single-user VR may be considered a «*communication interface*».

The question about how the interaction amongst these elements is designed and appropriately represented is fundamental for designing a *communication interface,* and has attracted intense interest since the end of the 1960s. One of the most significant aspects of designing sufficient user interfaces was the introduction of powerful metaphorical schemes. This is particularly true for VR, a medium that has the ability to involve users in sensory worlds, which are experienced in an almost identical manner with their experience of the real world. As explained in (2.1), VE systems are actually built on the basis of human abilities so the "natural" properties of a VR interface are closely related to the body and the perceptions of the person who uses or designs the system. Sensorimotor kinesthetic structures are the essence of the experience and the experiential structures "give a boost" to perceptual understanding and rational thought.

When we experience the daily sense of our presence in the physical environment, we automatically produce a mental model of an external space from the stimuli that our sensory organs receive as input (Loomis, 1992). In this manner, the continuous, constant and coherent sense of presence is the basic state of our conscience, whereby the user attributes the source of the sensation to the physical environment. When a user experiences a computer mediated simulation environment, Lombard & Ditton (1997) suggest that his experience is traversed by a common idea: the "perceptual illusion of non-mediation" or what Minsky (Bracken & Lombard, 2004: 24) has identified[4] as sense of *telepresence*. The experience of telepresence involves continuous and real-time responses of the perceptual, cognitive and affective processing systems of the user to

objects and entities that are placed within his environment. The illusion of non-mediation then implies that the user fails, to an extent, to perceive or to identify the existence of a medium, as a cause of this experience and reacts as if this medium were not there (Lombard & Ditton, 1997).

Harvey goes even further, suggesting that we think of VR in terms of *social presence* – and not mere *telepresence*– thus proposing to see VR as a culturally important phenomenon and not just a channel of connecting the world (1995: 376). Steuer (1992: 78-80) chooses to define VR in terms of human experience: «a real or simulated environment in which the perceiving person experiences tele-presence», where telepresence may be described as «the experience of presence in an environment through a medium of communication». All these approaches avoid a purely technological understanding of VR and presuppose that users, the phenomenon of presence and communication are all closely connected aspects of a VR experience.

Multi-user VR systems give justice to the definition of VR as a communication medium much more than single-user platforms do. ? Schroeder notes "the concept of a communication technology normally means that two or more people are involved and that the emphasis is given on the messages exchanged between them [...] Hence, that the concepts of communication and medium should be used only in the framework of multi-user VR" (1996, p. 146). Similarly, Barnes (2001) affirms that a technological medium becomes a communication environment when it is transformed from a tool to a medium of symbolic interaction between people. In fact, multi-user VEs can be considered as one of the forms of computer-mediated communication (CMC). By functioning as systems of interpersonal communication,[5] multi-user VR systems fundamentally alter the meaning of VR, as it has been conventionally understood at a technological as well as at a philosophical level. VR is no longer a collection of technical tools and hardware apparatuses, but primarily a tool of communication and interpersonal interaction, a social practice, a socio-cognitive environment. VR can be defined as an experiential form, a form of mediated experience, doing away with a purely technological approach.

It can then be suggested that a multi-user *collaborative virtual environment* (CVE) system is a communication environment, within the context of which, communication amongst remotely located, networked individuals is mediated. Taking into account the categorization of different levels of a communication process put forward by McQuail (1997:4), this type of environment functions at two different levels:

1.- At a *personal level* (human-computer communication), information is transmitted to users in various forms. This information has been created either by the entity that designs, implements and possibly supports and controls the operation of the CVE or is created by the participants themselves and is transmitted within the context of this CVE, thus utilizing its functionality for communicating messages. Communication at this level may either be synchronous or asynchronous.



2.- At an *interpersonal level* (human-computer-human communication), a CVE may function as the context that accommodates synchronous, interpersonal mediated communication of participants who are represented within this space by their individual digital agents in the form of avatars.[6] The existence of these audio-visually perceptible entities, which function as "bodies" for participants of the CVE, may enhance interpersonal communication amongst them with non-verbal elements (movements, gestures, facial expressions etc.).

## 3. Mobile and locative interactive systems supporting interpersonal mediated communication within the urban context

The emergence of wireless networks supporting multisensory, location-based communication amongst remotely positioned and potentially mobile individuals via a 3D human-computer interface is discussed in this section. Firstly, the technological background that enables these new types of hybrid mobile communication environments will be presented.

As discussed above, multi-user VEs redefine the meaning of sociality and mediated interpersonal communication. The evolution of hardware and software in mobile communication devices as well as the significant improvement in new types of mobile telecommunication networks allows for the introduction of interactive 3D technologies in mobile phone interfaces. Voice and text-based mobile communication technologies have already restructured the relation between the spatial context where mediated communication occurs and urban space. Consequently, the novel phenomenon of *mobile sociability* is slowly transforming the potential for social relations in public spaces of the city. Moreover, the gradual convergence of mobile technologies, telecommunication networks, geographical positioning systems as well as interactive multimedia and 3D interfaces on mobiles devices promises *a new form of communication*, that may expand and diversify the process of interpersonal communication and the very experience of urban space afforded to individuals who use these systems.

### 3.1 Mixed and augmented reality systems

The emergence of technologies that support the integration of real-time recorded and displayed video and 3D graphics on a user's display enable the experience of a *mixed* (MR) or *augmented reality* (AR).[7] Such systems actually provide the user with visual feedback that combines his real surroundings with a virtual world, mapping the one onto the other. What is very significant about these systems is their potential for affording a simulation experience that is freed from the spatial limitations of an immersive VE system. Indeed, Weiser (1991) has proposed the term *"embodied virtuality"*, to describe systems whereby virtuality is taken out of its electronic confines and is gracefully woven into the very fabric of our everyday real lives. While VR systems literally situate the user inside a computationally generated space, these "hybrid" VR systems may situate the user within the urban space. The essence of VR is the inclusive rela-

tionship between the participant and the virtual environment, while the essence of MR or AR is the active relationship between participant and a hybrid – virtual and physical – environment. In immersive VR systems, communication takes place through a wholly enveloping experience within a graphics environment, while in AR or MR systems communication occurs in a hybrid spatial context.

For example, a mobile AR game that takes place in the urban context, may place the player in a hybrid kind of space simultaneously comprising the electronically mediated spatial context as well as his surrounding physical settings. At the 2003 "Art & Communication" festival in Riga, one guest demonstrated a system for playing the popular online video game Quake in urban space (Tuters, 2004), as opposed to behind a desktop computer. Developed at the University of South Australia, this wearable computer was mounted into backpack and the 3D space of the video game was projected over the real world landscape through a head-mounted display, while the two projected environments were coordinated with the help of GPS technology (Piekarski & Thomas, 2002).

### 3.2 Electronically mediated experiences within the urban context

The contemporary urban environment in most developed countries of the world, incorporates various kinds of representations of reality, communicated to citizens via various media and appropriate display systems.[8] These environments may also incorporate systems, which capture visual, auditory and other types of information regarding human activity[9] and consequently utilize this input to affect the process of generating electronic representations. We can therefore put forward the hypothesis (Charitos, 2005) that *the incorporation of such systems results in an electronic enhancement of our everyday urban environment and that our communication with these environments and with other citizens who exist and act within them is mediated by these systems.*

In the context of these electronically enhanced mediated environments the sense of presence experienced by a humans may fluctuate amongst three different states (Biocca, Kim, 1997):

- *Presence in the physical world*: the most natural and non-mediated state of "being here", where man attributes the source of his experience to the stimuli emanating from his physical surroundings.
- *Presence in an electronically mediated "virtual" environment:* this could be any synthetic experience with environmental qualities, which is generated by making use of one or more electronic communication media. When the perception of information from his non-mediated physical surroundings is somehow restricted and his interface with the media allows him to concentrate on the mediated information communicated to him, he may experience a sense of "telepresence", as explained in (2.2).
- *Presence in an imaginary environment,* which is dominated by internally generated mental images[10].

In fact, a human may experience all three of these states at the same time but usually one of them prevails.



The sense of mediated presence within an environment may also be categorized into two different types of sense:

Physical sense of presence: which the human experiences when physically existing within or close by a mediated or non-mediated environment

Social sense of presence: which relates to the sense of proximity or co-existence with a virtual and possibly remotely located social entity.

Even though these two states are quite distinct, in some cases they may be mutually experienced, as in the cases of *video-conferencing systems* and *collaborative multi-user VEs*.

### 3.3 Introducing 3D graphics in mobile devices and mobility into interaction with 3D interfaces

A series of new technological developments regarding wireless communication networks[11] provide the opportunity for presenting multimedia content via 2D & 3D graphics and video on mobile handsets, thus communicating more information and in a more pleasurable and engaging manner than text-based content. One very effective type of multimedia with a proven high ability to hold user attention span is the use of interactive 3D graphics on mobile interfaces. Interactive 3D graphics content adds to the sense of depth of the representation and also affords more possibilities for presenting information on the limited surface of a mobile device display. Moreover, the ability to interact and determine the course of the representation may significantly enhance the engagement of participants with the evolving action (Beardow, 2002: 4).

Interactive 3D graphics interfaces have already proven to add significant value in the wired Internet and therefore is now showing considerable promise as a means to deliver information services, data and product visualization, online training, CRM and product support capabilities on wireless networks, in addition to a wide range of application possibilities (Beardow, 2002: 4). Interactive 3D has low bandwidth requirements, both in terms of bit-rate and timeliness of data arrival, and benefits from high picture quality and strong content stability under difficult reception conditions. 3D graphics are generated on the fly on the client device and therefore little load is placed on the network. This technology also allows for customization by the user, so that online personalities and animations can be created and send to others. These can also be connected to text based SMS messages, interpreting text and *emoticons*[12] within the text as expressions, actions or even lip-synching with voice mail. These facts have contributed to the gradual integration of interactive 3D graphics within the interface of mobile devices such as Personal Digital Assistants (PDAs) and cellular phones.

Such systems enable a new generation of services and applications supporting new forms of communication amongst users of wireless devices. One of these types of application are on-line 3D games, which have the potential for creating huge user on-line communities. There are no intrinsic limitations in multi-payer gaming in terms of maximum numbers of players or server loading.

In an online game however, 3D content is distributed to users either playing at home (on a graphics PC) or on the road (on a mobile). It is significant to stress the fact that the introduction of 3D graphics in mobile devices implies, at the same time, the introduction of mobility into interacting with 3D interfaces, as in the case of AR and MR systems and the possibility of both mobile and home users to participate concurrently in multi-user activities. One very good example of an artwork affording such an experience is the revolutionary work of new media performance group *Blast Theory* titled *"Uncle Roy All Around You"*[13]

Given their limited battery capabilities, mobile devices have typically less computational resources available than their counterparts that are connected to a power supply. This challenges content creators to design 3D content suited for every possible terminal.

### 3.4 Location Based Systems: introducing locativeness into mobile interfaces and its implications for the social experience within the urban context

New types of wireless communication networks enable the detection of user's position at all times via GPS or related technologies. This information is utilised by the system for updating the output displayed to the user, according to his dynamically changing location at all times. A new generation of location-based mobile games, which make good use of mobile and GPS technology, are beginning to emerge in Japan and Scandinavia. These systems may be called "pervasive", in that they are always present and encompassing multi-user communication systems. Pervasive games are location-based, which means that the player's location is mapped onto his position within the game's spatial context. If for instance, you are attacked in the game you have the option to fight an opponent or to run for real. Technically, location-based features are enabled by a system that identifies location in real time, either as a part of a mobile network (cell ID, TA, E-OTD) or a GPS system.[14]

In order to understand the social ramifications of locative communication media described above, it is important to investigate in detail, the impact that the kind of interpersonal communication they support has on our everyday experience within the urban environment. Souza e Silva (2004: 2) was one of the first to suggest the importance of these interactive communication environments (for playing, cooperation, socialising, etc) through which «virtual worlds immigrate from the internet to urban spaces». While the Internet allowed physical meeting places to «immigrate» to a "virtual" spatial context[15], the introduction of mobile location-based communication networks relates again the concept of a "meeting place" to the physical space of an urban environment[16]. Thus, social computing, which was previously restricted to the Internet is now brought back into the urban realm. Indeed, the emergence of locative-ness re-introduces the parameter of real location within the mediated communication activity, thus mapping the "virtual" mental space of communication to the physical space where the real bodies of communicating participants exist.

In location-based games, for example, the location of each player in the physical world, at each time, is very important[17]. In this manner, the virtual worlds of gaming are mapped onto the physical world and this hybrid spatial context becomes the arena of the game. It may then be suggested that urban physical space gains importance and is enriched with an essentially social quality: *locative media technologies pose location* not as a fixed parameter of design, but *as a practical condition of social encounters*, offering opportunities for action and interaction. These hybrid media, thus, bring back our attention to the social, cultural and intersubjectively constructed aspects that characterise urban space.



It is under this light, that locative media may be called systems of *situated, context-aware communication*. They are situated because they are rooted in the spatio-temporal nature of the physical world where interaction takes place[18]. Locative media are pervasive or ubiquitous environments, in that by functioning through the mobile phone they may surround the user, 24 hours a day, anywhere and anytime. In this sense, these systems are perfectly integrated in the space-time environment of users and connectivity itself becomes continuous, permanent, and synchronous to the movement of the individual user in the physical space.

Such situated communication systems may be contrasted with abstract communication systems. Abstract communication separates the message from the physical environment, whereas situated communication links them inextricably. Public space assumes new importance and new dimensions, through its «colonization» by mediation. New modes of social interaction may also emerge, such as gaming with strangers, dating etc. Technology can now be integrated into the everyday activities in the city. It is important to remember, however, that in situated mediated communication, we don't simply have to do with system users but with social actors who interact in a complex world and who participate in these electronic environments for pursuing various motives, aims and desires. Interpersonal communication is, after all, situational and situated by definition. Indeed, Stasser (1992) defined *interpersonal communication* as a process by which a group of social actors, in a given situation, negotiates the meaning of the various situations, which arise between them.

Evidently, this technology is essentially user-centric and as such, it demands new and more context-sensitive ways for conceptualizing, designing and studying it. The design of these systems should emphasise, even more than traditional user-centred human-computer interaction approaches, on supporting the actual needs of humans and groups as well as the social situations they find themselves in. Weiser's vision of *ubiquitous computing* (1991) and *ever-present connectivity* included the notion that technology should be designed to fit into our natural human environment. Accordingly, interfaces should closely model the way humans interact with the physical world and as has been explained in (2.2), this is one of the main principles that VR technology is built on. Similarly, locative-based mediated environments bring human-computer communication and human-computer-human communication back into the context of our

physical world, instead of expecting humans to adapt to the needs of a computer environment.

## 4. By way of conclusion: The future of mediated communication within the urban context

The social ramifications of communication media presented above are potentially significant. The convergence of new mobile telecommunication networks, geographical positioning systems and interactive 3D interfaces on mobile devices leads to new forms of interpersonal communication, that may significantly alter the experience of urban space as well as the relationship of the physical world with the technologically mediated environment experienced by individuals who use these systems. Both these technological systems and the physical settings, within which they function, may become tools of social practice, arenas of sociability, experiential places of human interaction, while reality itself may be augmented through a communication system that allows users to dynamically merge the simulation experience with physical stimuli afforded by the physical world.

If all this is true, can we be so optimistic as to believe that the dissemination of these technologies and communication practices will contribute to a regeneration of public space and of social life within it? While there are voices who claim that digital technologies may undermine urban life, this paper has attempted to present reasons for hoping that mobile and location-based communication technologies may afford highly mobile and individualistic 21st century city-dwellers the ability to connect to each other, to become more active and to recreate communities and bonds of socialization. A strong point can be made for the sociological importance of this technological hybridism. Public urban space in post-industrial highly urbanized societies is thought of as a space of anonymity, as a «non-space» (Auge, 1995). In this context, people pass by without forming relationships and without finding any meaning in this space other than merely moving from one point to the other, at a topological or geographical level.

Sociology and urban theory are full of narratives regarding the increasing de-localization, de-socialization or even disappearance of public space. If a place is a space enriched with meaning, that harbours human interactions and relations, then the modern city of flows and rapid movement is a space without places, without sociality or sociability, without interpersonal density. Mobile networked connectivity and locativeness may turn the urban space into a place of meaningfulness and sociality again. Tuters (2004) believes that mobile technology can transform the urban space of disconnected flows into a huge «peripatetic computer» of interpersonal contact that is a space full of potentially social places. This may lead to an electronically enhanced public space that can be enjoyed, as it regains life by becoming a setting for games, play, discovery, exploration, experimentation and socialization and as it aids city-dwellers who



are virtually strangers to meet in public places and engage together in various activities.

Given that we are used to think of the *virtual* as the antithesis of the *physical* and consequently as non-real, the arrival of location-based virtual environments forces us to reconsider the relation between real and virtual spatial experience. The arrival of mobile and wireless technology creates a new way of connecting to the Internet, transforming anew the boundaries and the meaning of the virtual (technological) and the real (physical). The reversal is obvious: while being wired to the Internet, we may exist in an immaterial world, disconnected from the geography of the material world while when connected via a mobile and locative system, the information sphere we access is related to geographical space.

The introduction of mobility into interacting with 3D interfaces and the possibility to access a VE, afforded concurrently to mobile and home users, creates very interesting prospects for such collaborative mediated experiences. With the aid of locative-based systems, space is being hybridised as the mediated spatial experience is mapped onto the physical urban environment, the virtual comes closer to the physical (De Souza e Silva, 2003: 2), allowing for new kinds of collaborative interaction and collective gaming. Therefore, locative media can be seen as extensions into the real, by literally becoming an extension of the human body, the human mind and the physical environment, thus fully justifying McLuhan´s theoretical visions. Locative media are experiential applications of social networking; they are "worlded" technologies, belonging to our everyday heavily mediated modern world. Moreover, they are dynamic, since their stability is not given but is rather determined by the fortuitous and complex interrelations amongst humans, interactions, situations and places.

Understandably then, mobile and locative technologies are seen as supporting novel and revolutionary new ways of inhabiting urban space. Communication is tied to places and places to communication. With the emergence of locative and mobile communication systems, the city may again become a social arena. In the words of Thackara (2003) it may become a "post-spectacular city", where digital technologies are used for meaningful human interaction.

**Notes**

1 Geographical Positioning Systems (GPS)

2 Technologies supporting VR systems are: real-time interactive 3D graphics, position and orientation tracking devices, stereoscopic displays, projection systems, augmented reality displays etc.

3 Examples of activities that need to be learned are: the use of a mouse for selecting and manipulating an object within the context of a 2D interface, scrolling down a scroll bar for reading a document, etc.

4 Minsky has proposed this term in the context of teleoperation technology.

5 Gumpert & Cathcart (1986:30) used the term «interpersonal mediated communication» which they defined as «any human-to-human interaction where a medium intervenes in order to transcend space and time restrains». In the case of a multi-user communication environment, VR may be evaluated as a medium of interpersonal communication in the same way as other media of interpersonal communication, like the tele-

phone, email, forums (Palmer, 1995: 291).

6 McLellan (1994: 33-35) defines "avatars" as the only representations of the participants' bodies, which are displayed to them in an immersive VE system.

7 *Mixed* and *augmented reality* systems are fully interactive systems that displays to the user visual output, the source of which is a simultaneous integration of a synthetic 3D computer graphics world and real-time video footage of his surrounding environment. One representation is accurately mapped onto the other so that they produce a coherent and continuous visual experience.

8 For example: large size prints, video projections, wall paintings, TV closed circuits, etc.

9 For example: video cameras, microphones, sensors, etc.

10 Images may be visual, auditory, olfactory etc.

11 For example: new data delivery capabilities, higher resolution color screens, 3D standards for mobile handsets, enhanced processing capability for mobile devices.

12 Icons that express emotions.

13 This work has been experienced by one of the authors during the Futuresonic conference in Manchester in 2004 and information about it and other related Blast Theory projects can be found at their web site: www.blasttheory.com

14 Based on information from a company's site ("It's Alive") that produces and distributes one of the first location-based games at: www.itsalive.com

15 The spatial context implied here is the mental space where communication in a text-based MUD or MOO occurs.

16 The streets, the squares, the parks, the means of transport, the city as a whole.

17 When, for example, the player approaches such a location his telephone notifies him of his whereabouts, while at the same time, his physical location is mapped onto the game's visual representation for all players to view.

18 The concept of «social situatedness», although first put forward in the 1920s by the work of Lev Vygotsky, has recently received much attention in cognitive science and artificial intelligence research (Suchman, 1987). The notion of situatedness denotes that the development of individual intelligence requires a social and cultural embedding, that humans are situated agents and that human cognition is emergent from the interaction of the human with the environment.

**Bibliography**


AUGE, M. (1995). *on-places. Introduction to an anthropology of supermodernity*. London: Verso.

BARDINI, T. (1997). "Bridging the Gulfs: From Hypertext to Cyberspace". *Journal of Computer Mediated - Communication*, 3(2), Available at: http://www.ascusc.org/jcmc/vol3/issue2/bardini.html.

BARNES, S. (2001). *Online Connections*. New York: Hampton Press.

BEARDOW, P. (2002). "Enabling Wireless Interactive 3D", article retrieved from the Superscape Plc. official web site at: *www.superscape.com* in June 2004.

BIOCCA, F., & DELANEY, B. (1995)."Immersive virtual reality technology". In F. BIOCCA, F. & LEVY M. R. (Eds.), *Communication in the age of virtual reality*. Hillsdale, NJ: Lawrence Erlbaum Associates. p. 57-124

BIOCCA, F. & LEVY, M. (1995). "The vision of virtual reality". In BIOCCA, F. & LEVY, M. (eds.), *Communication in the age of virtual reality*. Hillsdale, New Jersey: Lawrence Erlbaum Associates. p. 3-14

BIOCCA, F. & KIM, T. (1997). "Telepresence via Television: Two dimensions of Telepresence May Have Different Connections to Memory and Persuasion". *Journal of Computer Mediated Communication*. Vol. 3 (2).

BRACKEN, C.C. & LOMBARD, M. (2004). "Social Presence and Children: Praise, Intrinsic Motivation, and Learning With Computers". *Journal of Communication*. March 2004. International Communication Association. p.22-37

CHARITOS, D. (2005) "Virtual Reality: A new kind-of human-computer interface or a new communication medium ?". *Issues of Communication* (Zitimata Epikinonias), Vol. 2, Athens: Kastaniotis. (In Greek).

ELLIS, S. R. (1991). Nature and origins of virtual environments: a bibliographical essay. *Computing Systems in Engineering, 2*(4), p. 321-347.

GUMPERT, G. & CATHCART, R. (1986) *Inter/Media: Interpersonal communication in a media world (3rd ed.)*.

HARVEY, L. (1995). "Communication Issues and Policy Implications". BIOCCA F. & LEVY M.R. (eds), *Communication in the age of virtual reality*. Hillsdale, NJ: Lawrence Erlbaum Associates. p. 369-387

LOMBARD, M., & DITTON, T. (1997). « At the heart of it all: The concept of presence". *Journal of Computer-Mediated Communication*, Vol.3, *(2)*. Available at: *http://www.ascusc.org/jcmc/vol3/issue2/lombard.html*

LOOMIS, J. M. (1992). "Distal attribution and presence". *Presence, Teleoperators, and Virtual Enviroments*, 1(1). Massachusetts: Press. p. 113 – 118.

MCLELLAN, H. (1994). "Beam Me Up to My Avatar". *VR World*, March/April 94. Mecklermedia.

MCQUAIL, D. (1997). *Mass Communication Theory: an Introduction*. Athens: Kastaniotis.

MEIMARIS, M. (1997). "Development, applications and perspectives of Virtual Reality". In Proceedings of the International Conference "From Computer Graphics to Virtual Reality", Athens: Publications.

PALMER, M. T. (1995). Interpersonal communication and virtual reality: Mediating interpersonal relationships. In BIOCCA F. & LEVY M.R. (eds.). *Communication in the age of virtual reality*. Hillsdale, NJ: Lawrence Erlbaum Associates. p. 277-299.

PIEKARSKI, W. & THOMAS, B. (2002) "ARQuake: The Outdoors Augmented Reality System," Communications of the ACM, vol. 45, no. 1, Jan. 2002, ACM Press. p.36–38.

SCHROEDER, R. (1996). *Possible worlds: The social dynamic of virtual reality technology*. Boulder, CO: Westview Press.

SOUZA E SILVA, A. (2003). "*Mobile Networks and Public Spaces – bringing multiuser environments into the physical space*", Proceedings of the 2003 International Consciousness Reframed Conference, Ascott, R. (ed.), University of Wales College (in print).

STASSER, G. (1992). Pooling of unshared information during group discussion. In WORCHELL S., WOOD W, & SIMPSON J.A. (eds.), *Group processes and productivity*. Newbury Park, CA: Sage. p. 48-67.

STEUER, J. S. (1992). Defining virtual reality: Dimensions determining telepresence. *Journal of Communication, 42*(4). p. 73-93.

SUCHMAN, L. (1987). *Plans and Situated Actions: The problem of human-machine communication*, Cambridge University Press.

THACKARA, J. (2003). "The post-spectacular city", lecture at Creativity and the City Conference, Amsterdam, 25 September 2003.

TUTERS, M. (2004). "*The Locative Commons: Situating Location-Based Media in Urban Public Space*", Electronic Proceedings of the 2004 Futuresonic Conference, Manchester.

VARELA, F. J. (1992). "The reenchantement of the concrete". In J. CRARY & S. KWINTER (Eds), Zone 6: Incorporations. New York: Urzone. p.320 – 338.

WEISER, M. (1991). "The Computer for the 21st Century". *Scientific American*, 265(3). p. 94-104. Available at: http://www.ubiq.com/hypertext/weiser/SciAmDraft3.html