



Prof. Hans Geser
Online Publikationen

Universität Zürich
Soziologisches Institut



Sociology of the Internet

Augmenting things, establishments and human beings

“Blended Reality” in a psycho-sociological perspective

Hans Geser
Zürich, March 2010

*“...we’re going to end up with the Internet smearing itself all over the world around us.”
(Charles Stross 2009)*

Abstract

In contrast to virtual reality that diverts attention to artificial “second worlds” and robotics that substitutes human beings by artificial agents, “Augmented Reality” aims to reinstate the human being as the very center of all digital activities: not only as an abstract “subject”, but as an embodied actor interacting with the physical environment by using his senso-motoric skills. Especially when harnessed with geotracking systems (GPS) and crowdsourced databases, AR applications provide more relevant information about any current environment on a Real Time basis: thus reducing potentially the scope of subjectivity by “colonizing” even most basic human perceptions and behavior with objectified supraindividual information. When human beings are the targets of augmentation, new devices of reciprocal data control will have to be established in order to keep an equilibrium between the advantages to observe others and the need to preserve privacy (=remain unobserved).

Inhaltsverzeichnis

1. What is it all about?	2
2. From “virtual” to “blended” realities	5
3. An epistemological approach: AR as a tool for expanding “horizons of reference”	7
4. A (gestalt-)psychological view: AR as a means for empowering processes of “emergence” and “reification”	9
5. Some (current and prospective) functions and consequences of AR for individuals, society and culture	10
6. Augmenting persons: the shift from communicative to observational social relations	20
7. Conclusions	24
References	26

Citation: Geser Hans: Augmenting Things, Establishments and Human Beings. In: Prof. Hans Geser: Online Publications. Zuerich, March 2010 http://geser.net/intcom/t_hgeser24.pdf

1. What is it all about?

In the annals recording the evolution of digital technologies, 2009 will be remembered by the rather sudden upsurge of applications grouping themselves under the heading of “Augmented Reality” (AR). While diverging widely in their characteristics, aims and functions, they are all based on advanced mobile hardware devices (particularly smart phones), and they have all in common that they extend the potentials of computing technology to broader spheres and deeper levels of human behavior and everyday life.

Here are some examples:

1) Vision enhancing applications

In urban areas, the stream of data generated by CCTV cameras can be synthesized in a way to make house walls on street crossings appear transparent to approaching car drivers – thus allowing smoother driving and preventing accidents (Giles 2009). Similarly, human surgery is supported by AR imaging devices which project virtual 3-D pictures from inside the body right into the visual field of ongoing surgical manipulation.

“Previously, surgeons were limited to having constantly to alter their field of vision by looking away from the operating site and comparing this to a static graphic scan or representation. Augmented reality allows them to maintain a fixed field of vision on the surgical site while having graphic scans augmented over the top for reference or guidance.”¹

2) Hybrid object applications

Any physical object can be connected to a layers of virtual reality, so that it becomes just a “transport mechanism” and a gateway to a superimposed virtual world.

„This is shown by the MagicBook work ...in which a real book is used as a Tangible AR interface object. Several users can read the book like normal. However, when they look at the book pages through a handheld display they see three-dimensional virtual scenes overlaid on the real page. When users see a scene they like they can “fly” into it and experience it immersively. In this way the book is a transport mechanism that can move people between reality and virtuality.“
(Billinghurst/Kato 2002.

3) Pattern recognition applications

“Tyberis Music Database is a stand-alone freeware program which is able to recognize thousands of different musical pieces or other audio data in real-time. TyMusicDB is capable of identifying a song based on only a very small fragment of it. It will recognize a song at any point. The recognition algorithm is designed to identify songs based on their acoustical properties and is thus very robust against noise and other distortion. If the input signal is sufficiently strong and has little distortion (e.g. FM tuner) a sample of only 1 second in length will suffice for a correct identification.”²

In an analogous fashion, Google Goggles allows to send any kind of pictures to a central lab where they are analyzed on the basis of all previously accumulated information. Thus, holding the camera on a book or a DVD cover, a bar code, a wine etiquette or a commercial logo is sufficient to get desired

¹ Augmented Reality-aided Surgery. Is it real ?

http://www.roboticsurgery.gr/index.php?option=com_content&view=article&id=85&Itemid=60&lang=en

² <http://music.tyberis.com/>

background information.³ In a not too distant future, it may be possible to know the species of a plant by capturing an image of its leaves, or to get advice about next chess moves by submitting the present configuration on the board.⁴

4) Face-recognition applications

AR applications can revolutionize the world of primary social interactions by helping to identify individuals by recognizing their face.

"Harnessing Face.com's superior facial recognition algorithms and its enormous database of faces, the 'Social Augmented Reality' app functions in multiple capacities:

- **Friends:** *When two friends are together and one wants to see the other's photos, the software will recognize the friend and offer direct links to his or her profile and pictures,*
- **Business:** *At the office, a colleague might request that you remind him or her about a report that is due. A quick scan and the app will identify the individual, allowing you to message him or her without ever looking through your address book.*
- **Acquaintances:** *The app has the potential to connect people before they even know each other's names. If you bump into someone who you met before and he or she looks familiar but you can't remember why, the app will locate that person's online profile to put a name to the face."*⁵(Barrett 2010).

5) Location aware applications

By ascertaining the precise geographic location of the user via GPS and the direction in which he holds the camera (with an internal compass), the *Wikitude travel guide* is able to know at which monument the user is currently looking. This real time information is then coupled to the information about the respective monument stored in the Wikipedia and is made automatically available to the users in the form of markers and summaries on the screen: at the precise place where the monument is seen.⁶ Similar potentials are offered by the *layar browser*⁷, or by Nokia's "*Point & Find*"⁸ application which extends information to more variable targets: "*Simply by pointing their camera phone at a poster for a new movie, people can watch the trailer, read reviews, and find the closest cinema where it is playing.*" (Kobie 2009).

6) Location-Based Social Networks: Mobile Buzz by Google

"Mobile Buzz uses tons of location-based data from your smartphone's A-GPS circuitry to work out where you are, and then feeds that information to your Buzz friends, should you chose to transmit it. It even combines your information to work out your location in a colloquial language-- not merely asking, 'Are you at 7 World Trade Center?' but rather, 'Are you at work?' Google's algorithm then scours through the mass of all ongoing Buzz and shapes some of the content to what it thinks you'd prefer to see, before delivering to you the 'nearby Buzz'. Which will include stuff from friends, people Google thinks you may be interested in hearing from and, of course, companies that may try to sell you their wares." (Eaton 2010).

³ <http://www.google.com/mobile/goggles/#landmark>

⁴ <http://www.google.com/mobile/goggles/#landmark>

⁵ Press Release on The Mobile World Congress in Barcelona 2010, cited in Barrett 2010.

⁶ see <http://www.wikitude.org/category/wikitude>

⁷ <http://layar.com/>

⁸ <http://pointandfind.nokia.com/>

7) Collaborative user-generated tagging

“Sekai Camera is focused on letting users communicate through digital tags that float in the real world. For example, users can go to a café, take photos, leave comments about what the best thing on the menu is, leave voice notes at the café, and all of these can be accessed by the next person that goes in there and turns on their Sekai Camera. These notes show up on the screen as little bubbles you can access while pointing your iPhone around the location. (Caceres 2009)

Similarly, [GraffitiGeo](http://www.graffitigeo.com/)⁹, ‘combines restaurant reviews with social gameplay, are working on an iPhone app that will allow users to point the phone’s camera at a venue and see an overlay of relevant comments about it from other users.’ (O’Reilly 2009).

Even more powerful is ‘Geonote’ which enables users to create a virtual note “by typing in text (via a digital keyboard), sound (microphone) imagery (a camera on the device) or a drawing (digital whiteboard). Placing the GeoNote ‘here’ involves specifying the radius in which it will be active for other users (e.g. 2-40meters). GeoNotes can also be placed on other geographical positions than at the one the user is presently located (through a zoomable and clickable map interface).” (Persson, Espinoza & Cacciatore 2001:1).

All these examples have in common that computer technology is instrumentalized for providing individuals with additional knowledge and action capacities vis-à-vis their local Real World environment. This is done by overlaying computer-generated data onto a person’s field of primary sensory perception: so that a hitherto unknown form of “blended reality” is created.

As a powerful *user interface technology*, Augmented Reality always implies that computer potentialities are “slaved” in three ways to RealWorld conditions:

- 1) In the *spatial dimension*, AR means that computer capacities are available right on the spot where an individual is located. This presupposes powerful mobile devices (like smart phones) as they have emerged within the last years, as well as a connection to geotracking technologies like GPS.
- 2) In the *temporal dimension*, AR implies that digital information is delivered in Real Time (Azuma 1997). Thus, mobile devices have usually to be wired to the Internet, so that any relevant data can be retrieved without any delay.
- 3) In an *object-related* sense, AR is based on tight, precisely defined interrelationships between physical objects and developments on the one hand and virtual data on the other (Azuma 1997). Such “registrations” usually presuppose large bodies of highly reliable *ex ante* knowledge which may be well available for the construction of museum guides, but much less for unpredictable developments and newly emerging entities.

The concept as well as the first applications of “Augmented Reality” have originated unquestionably in the realm of industrial production, The term was first used by Tom Caudell, a Boeing aircraft engineer, in 1990, when workers were equipped with head mounted displays that helped them to furnish new airplanes with complex electrical installations (Chen 2009).

In the 1990s, the first AR products addressed the needs of such specialties as medicine and engineering. Developments were very slow until 2009 where an impressive take off occurred – on the supply side as well as in public opinion. In summer 2009, Google Trends recorded a sudden upsurge in the frequency

⁹ <http://www.graffitigeo.com/>

the term “augmented reality” was used in searches: for the first time surpassing “virtual reality” (which experienced a steady decline since 2004; Schonfeld 2010).

2. From “virtual” to “blended” realities

In its early stages, the Internet was conceived by notions such “Virtual Reality” or “Cyberspace”. Both concepts imply a radical segregation between two spheres of human experience and human action:

- a plane of “reality” governed by “natural” restrictions of physical space and matter;
- a plane of “virtuality” constructed artificially by software applications and computer-mediated interaction.

The concept of “Cyberspace” helped to bridge (or rather: parallelize) the two spheres in metaphoric terms: by conceiving the digital sphere as a kind of “container” within which virtual objects (like metaphorical “desktops”, “folders”, “paper baskets” etc) could be placed (Johnson 2002) and various kinds of virtual locations (like web “sites”, “home” pages, chat “rooms” MUD’s or massive multiplayer online games like “World of Warcraft”) could be designed.

However, such parallelisms were doomed to result in a dead end: a “schizophrenic” situation forcing people to divide their conscious attention (their most scarce psychological resource) between Reality and virtual planes (Biocca et al. 2009). Thus, it is extremely cumbersome to live an additional “Second Life” where I’m committed to develop a full-blown Avatar identity (Geser 2007), to develop purely virtual social relationships, to save and invest my “virtual money” with maximum profit and to care diligently for a my virtual “Real estate”.

In a general sense, computer interfaces create an “artificial seam” (Billinghurst/Kato 2002) that constitutes an obstacle to fluent interpersonal collaboration, by forcing individuals to enter a virtual world separate from their physical environment.

As Manovich has stated, the electronic screen just continues a long tradition of “chaining” the user to a specific immobile location:

„From Renaissance monocular perspective to modern cinema, from Kepler’s camera obscura to nineteenth century camera lucida, the body had to remain still (Manovich 2001: 106).”

People looking at a projection screen or crowded around a desktop monitor are evidently less able to concentrate attention on real objects or physically present persons. For example, observations of the use of large shared displays have found that simultaneous interaction rarely occurs due to the lack of software support and input devices for co-present collaboration [Pedersen 1993]. This diversion is most negative when collaboration involves *the manipulation of physical objects*: because attention has then to oscillate between computer display and these objects – two different, unrelated worlds.

As a consequence, computer usage has hitherto been restricted to situations where work centers on the manipulation of data and symbols, not of physical objects – thus creating a “digital divide” between “white collar” populations working on the PC all day and “blue collars” that have almost no direct contact with digital technologies. This is a handicap in all situations where efficient working demands a seamless frequent change between virtuality and physicality: e. g. in tasks of design and construction.

A similar diversion exists when work demands primary interpersonal interaction: because immersion in virtual world always reduces nonverbal communicative exchanges (Kiyokawa et. al 2000] This is a handicap when the motivating climate, immediacy and flexible feedback of primary face-to-face interaction

has to be combined with the usage of complex data sets, symbolic models and logico-mathematical operations, or with freeing collaboration from restraints of time and space (Chernenko 2005).

Given these heavy constraints, there is an objective need to redefine the relationship between the Real and the Virtual in a completely new way: by seeing them no longer as *substitutes* competing for our commitments, but as *complements* that can be synthesized for maximizing our capacity for coping successfully with *The One Real World*.

“Augmented Reality” is a logical correlate of this fundamental turn: by substituting “virtual realities” with “blended realities” that don’t *loosen*, but *strengthen* our relationship with our local offline environment. Rather than immersing people in an artificially created virtual sphere, the goal is to augment objects in the physical world by endowing them with a wealth of digital information and gateways to communication. More specifically, the aim of AR is „to supplement reality by adding virtual objects into a real-world view” (Kangas & Ronning 2002: 199), in order “to create high level of consistency between real and virtual environments.” (Bimber & Rashkar 2002: 199).¹⁰

It was no accidental coincidence that at the same time when the AR concept was initiated, Mark Weiser coined the concept of “ubiquitous computer”: arguing that heavy stationary computer sets should be replaced (or supplemented) by a multitude of distributed digital devices, each tailored to a specific field of human activities and to a narrow range of tasks. (Weiser 1991). The concept of “ubiquitous computing” implies the perspective that computing technologies would (or should) evolve in the same way as systems of energy production and heating. In the initial phases, these technologies take the form of highly visible, segregated objects (like stoves, boilers, generators etc.) that are fixed to specific locations, so that it is difficult to harness them flexibly to the activities of everyday life. In the longer run, such rigid devices are replaced by much less obtrusive structures that deliver their functions pervasively through space and time: e. g. systems of central heating keeping every corner of a building on a specific temperature level, or grids of electricity that provide energy anywhere by day and night for all purposes.

In all these cases, *ubiquity goes along with unobtrusiveness or even invisibility*: in the sense that technological equipment vanishes in the background, so that it doesn’t interfere with any human activities or social structures. Thus, electricity has freed enterprises to choose any geographical location, and central heating frees people from burdensome auxiliary tasks like shoving coal and lighting a new fire every morning (Buxton 1997).

By analogy to these historical developments, the evolution of the Computer technology has to be projected as a process aiming at total invisibility of technological devices (Norman 1998).

„UbiComp is the computational analogy to this mature phase of heating systems: in both, the technology is seamlessly integrated into the architecture of the workplace. Within the UbiComp model, there is no computer on my desk because my desktop is my computer. As today, there is a large white board on my wall, but with UbiComp, it is active, and can be linked to yours, which

¹⁰ A similar turn toward a complementary relationship between the Real and the Virtual is manifested by the rise of Social network Sites (like Facebook, MySpace, LinkedIn etc.) Here, the focus is on instrumentalizing virtual tools for enhancing human personalities irrespective of physical location by providing everybody with a platform for organizing his social relationships and interactions. Augmented reality is highly complementary to Social Network Sites insofar as it focuses not on human personalities as nodes of transspatial interaction, but on physically present human beings.

may be 3000 km away. What I see is way less technology. What I get is way less intrusion (noise, heat, etc.) and way more functionality and convenience. And with my Pads and Tabs, and the wireless networks that they employ, I also get far more mobility without becoming a computational ,orphan'." (Buxton 1997).

As a special case of ubiquitous computing, "Augmented Reality" applications enable individuals to mobilize the potential of digital technologies at any time, on any location and under any situational conditions. Evidently, the availability of laptops, Smart Phones or other mobile of computer devices is a necessary, but certainly not a sufficient condition for a deeper penetration of digital computing and storage capacities into everyday human life to take place, because even mobile screens can still absorb our attention, so that we are not able to watch our physical surroundings at the same time.

By contrast, head-mounted displays are far better because they allow *"us to see images of the real world and computer generated images in the same field of view in such a way that they appear to be part of the same reality."* (Berry 2008).

In the future, we will certainly see the rise of even less obtrusive gadgets weared on the body. e. g. by "smart eyeglasses" with the capacity to "teleprompt" the manuscript I present orally before an audience, or to give me cues about the quality of a restaurant when I pass it on the street. Similarly, "smart hearing aids" may not only amplify acoustic signals for compensating hearing deficiencies, but also be able to produce real time translations of speech into any desired language.

In sharp contrast to robotics and all other endeavors to substitute human beings by artificial agents, AR aims to reinstate the human being as the very center of all digital activities: not only as an abstract "subject" in the view of Husserl's transcendental phenomenology, but as an embodied actor interacting with the physical environment by using his senso-motoric skills (Hansen 2006).

"Augmented reality is a completely human-centered technology. Unlike the quest for artificial intelligence, robotics, or some other "smart-technology" research designed to eliminate the need for humans in favor of decision making by computers, AR will enhance human performance directly, allowing people to work both faster and smarter and in full control of technology, instead of it controlling them."

Thus, AR is empowering users to cope more fully and effectively with their physical surrounding by providing richer information about its objective characteristics on a Real time basis: far beyond what they can see, hear, smell or touch at any given moment and from their particular spatial position.

3. An epistemological approach: AR as a tool for expanding "horizons of reference"

The transcendental phenomenology of *Edmund Husserl* has taught us that human experiences is organized in a way that everything empirically *perceived* is carrying with it a manifold of *"appresentations"* that are only *known*.

Thus, to conclude from a sensory impression that "this is a table" means to transcend that which is empirically given by far reaching inferences and projections that have a high degree of certainty despite the fact that they are not grounded in current sensory verification: e. g. by "knowing" that the object has an unseen backside, possesses mass and weight, and must be the outcome of an antecedent process of industrial production etc.

“Every act of experience, whatever it may be that is experienced in the proper sense as it comes into view, has eo ipso, necessarily, a knowledge and potential knowledge having reference to precisely this thing, namely, to something of it which has not yet come into view. This preknowledge is indeterminate as to content, or not completely determined, but it is never completely empty; and were it not already manifest, the experience would not at all be experience of this one, this particular, thing. Every experience has its own horizon; every experience has its core of actual and determinate cognition, its own content of immediate determinations which give themselves; but beyond this core of determinate quiddity, of the truly given as 'itself-there', it has its own horizon. This implies that every experience refers to the possibility--and it is a question here of the capacity of the ego--not only of explicating, step by step, the thing which has been given in a first view, in conformity with what is really self-given thereby, but also of obtaining, little by little as experience continues, new determinations of the same thing” (Husserl 1973: 32.).

Thus, all human perceptions have a hybrid structure: the table as I *see* it is a purely *subjective* experience determined by my local point of view, current light conditions and other particularities; the table as I *conceive* it is a transempirical notion purified from such subjective factors, a decontextualized, objectified entity that is part of This One World (as an intersubjectively constituted construction).

Some of these “horizons of reference” (“Verweisungshorizonte”) are automatic, uncontrollable and nonmodifiable corollaries associated with the intrinsic properties of an object: e. g., that a 40 year old tree must also have existed 10 years ago, or in the case of a triangle: that the sum of its three angle must be exactly 180 degrees. Others are of course highly dependent on the state of empirical (scientific) knowledge. e. g. by inferring that feverish temperatures indicate an infection, that whales are mammals or that falling air pressure predicts imminent rain.

The evolution of knowledge proceeds in way that ever less empirical data are necessary for opening up ever wider horizons of (highly certain) inferences: so that smallest snippets of DNA are sufficient to reconstruct the animal or plant from which is originated, and spectrographic evidence from extremely remote galaxies allows reliable conclusions not only about their chemical composition, but even about the origin and evolution of our universe.

In this philosophical perspective, Augmented Reality is just a new step in the expansion of such “horizons of reference”: by harnessing empirically given sensory impressions to additional pools of information that help to give a richer meaning to what is heard, smelled, touched or seen, and by increasing the degree to which everything subjectively experienced is permeated by decontextualized supra-individual knowledge that is part of collective culture and can thus be intersubjectively shared. More and more, objects and locations will thus be endowed with ever expanding “information shadows” (O’Reilly & Pahlka 2009) that can be made visible (or left invisible) according to the preferences of users.

In a more powerful way than ever before, advanced AR applications free the individual user from its particular subjective perspective: by providing information about the past, about features too small to be seen or noises too soft to be heard with one own senses, or by providing perspectives seen from other angles or from places not physical accessible by a human observer (e. g. a patient’s inside view of his own bodily organs).

4. A (gestalt-)psychological view: AR as a means for empowering processes of “emergence” and “reification”

From a psychological perspective, AR applications have good chances to be implemented extensively because they just complement and amplify already existing human capacities that are involved in all processes of sensory perception. Thus, the fundamental insight of “Gestalt psychology” is that “Reality Augmentation” is a basic, ubiquitous performance of the human mind.

First of all, this is seen in the phenomenon called “emergence”: the spontaneous tendency of human beings to synthesize fragmented data and observations into meaningful wholes (Wyatt 1928; Koffka 1935).

“(Emergence) is the principle leading to the perception of a given form, even if can be seen initially as a random pattern or a irregular form; the complete form is fully perceived even its perimeter is missing or become undistinguished from other less important perimeters.” (Della Favera /Medeiros 2007).

Evidently, the “tricorder” (as it has been presented fictionally in the Star Trek universe) amplifies such capacities by extracting from the environment many fragmented snippets of empirical data which then can be synthesized to a unified picture (e. g. about the state of local air pollution; Anthes 2009). In contrast to “spontaneous” synthetic activities performed by individuals, such artificial devices allow to extend these same functionalities to interindividual and supraindividual levels. This is seen in many crowdsourcing applications where fragmentary snippets of information stemming from many different individuals are aggregated in order to gain a meaningful picture of an event or development (e. g. information systems about traffic congestions; Terdiman 2009).

The second spontaneous, “inborn” strategy of cognitive reality upgrading is “reification” (Wyatt 1928; Koffka 1935), a concept referring to

“the constructive or generative aspect of perception whereby the experienced percept contains more explicit spatial information than the sensory stimulus on which it is based.” (Della Favera /Medeiros 2007; Lehar 2004).

The main function of most AR devices is exactly to enhance such capacities of reification: e. g. by connecting the sensory perception of an object with a pool of additional information which refers to object characteristics that are not empirically available: e. g. its history, its covert internal structures or its relations to other objects in other locations. “Reification” means that all such augmentations increase the degree to which a specific object is seen as a self-contained entity segregated from other objects as well as from its surroundings: a focus which attracts ever more human attention the more information about it (and nothing else) is delivered. This is well illustrated by the “Wikitude” browser which carries the atomistic segmentation of reality (a general characteristic for all encyclopedias) onto the level of everyday human life.

Finally, AR also supports countervailing human dispositions aiming at a *reduction* of complexity as they are cached by the “Prägnanz” concept (Wertheimer 1923): e. g. the tendency to automatically “correct” an imperfect to a perfect circle, or by just overlooking small aberrations which ‘disturb’ an overall impression of invariance. Evidently, these same simplifying procedures are applied – and just extended – in all kinds of environmental modeling (e. g. mapping) applications (e. g. Höllerer & Feiner 2004).

5. Some (current and prospective) functions and consequences of AR for individuals, society and culture

5.1. Facilitating undivided, highly focused attention

The time- and labor-saving functions of such overlay devices are particularly evident in activities where uninterrupted concentrated attention on a single object or process is critical for accomplishing a specific task: e. g. when car drivers seek for the right direction under conditions of heavy traffic, or in the case of surgical operations.

Similarly, cooking a meal can be done more efficiently when I don't have to consult the recipe book repeatedly in order to know what to do next, because such information is presented to me in virtual writing laid over the kitchen board where I'm currently standing (see Bonanni/Lee & Selker 2005).

"Or consider being able to scroll through a set of notes while giving a talk, without breaking eye contact, essentially using the equivalent of a head-worn teleprompter." (Feiner 1999: 146).

Oral presentations can additionally be supported by "eye tracking" devices that

"...observe a person's pupils with tiny cameras to determine where that person's gaze is directed. As a pointing device, it could eliminate the need for an entire step of coordinated muscle activity that other pointing devices require in order to move a pointer to a location that was found through eye movement in the first place." (Höllerer & Feiner 2004: 26).

Research has shown that interpersonal speech and behavior is quite similar to unmediated face-to-face conditions when collocal workers deal with augmented real objects, in sharp contrast to collaborations mediated by a screen.

„This is because when people collaborate at a table they can see objects on the table at the same time as each other, thus the task-space (the space containing the objects) is a subset of the communication space. However when users are collaborating in front of a screen the task space is part of the screen space, and may be separate from the interpersonal communication space.“ (Billinghurst & Kato 2002).

Thus, AR revolutionizes teleconferencing because remote participants are no longer brought by pictures on screen, but by virtual representations that can be placed flexibly at any place in the physical environment, so that they become part of a unified encompassing "situation" seamlessly integrating real and virtual participants in the field of visual, auditory and tactile cognitions.

„In a user study that compared AR conferencing to traditional audio and videoconferencing subjects reported a significantly higher sense of presence for the remote user in the AR conferencing condition and that it was easier to perceive non-verbal communication cues. One subject leaned in close to the monitor during the video conferencing condition, and moved back during the AR condition to give the virtual collaborator the same body space as in a face-to-face conversation!“ (Billinghurst & Kato 2002).

All these examples show how AR technologies can be devices for reintegrating our personal field of experience: by eliminating the need to divide our attention up between computer screen and physical manipulations, or between written paper and oral presentation.

5.2 Filling the widening gap between outward appearance and internal properties

Of course, transempirical information made available by AR devices is most needed when very crucial properties of an object, event or process cannot be grasped with the senses.

Evidently, the “information shadows” of all things constantly increase as a result of the advance of knowledge of all kinds: knowledge referring to the microscopic (e. g. molecular or cellular) levels of an object, its genesis and history, or its relationship to other (visible and invisible) things.

As an illustration, most consumer goods have the intrinsic attribute that their current visible appearance doesn’t give the most needed information: how will the new carpet look like when it is heavily used over five years? Will the garment shrink when it is washed with 60 degrees? Recently, need for such background information has increased for ethical reasons. For instance, consumers want to know whether items have been produced in an ecological fashion, without animal maltreatment or child labor and with decent, healthy conditions for the respective workers.

“Knowing where products are sourced, particularly food products, is becoming a key issue for the ethical consumer of today. Now consumers can use the camera on their mobile handset to scan a 2D (QR) barcode to access information about the product, such as a best-before date or carbon footprint. With AR, the barcode is not necessary because the software can recognize an image - a product label, for example - and display the same product source information.” (Bardwell 2010).

The role of transempirical knowledge also rises constantly as a correlate of technological evolution. Thus, looking at a computer or video player doesn’t inform me at all about the relevant properties of such devices because no intrinsic relationships between their simple external appearance and their immensely complex functionalities exist.

Finally, newer trends in clothing styles as well as in architecture makes it more and more difficult to draw reliable inferences from outward appearance to internal conditions. Thus, “people enhancing devices” are particularly useful in modern societies where people have so many different skills, views, knowledge resources and action capacities while all present themselves in the same conventionalized clothes (e. g. all males in grey to black suits).¹¹ The need would have been less in medieval societies where the social status and functional role of individuals was visibly expressed by their visual appearance: their clothing and haircuts or even their language and behavioral patterns. In a very objective sense, then, modern live conditions go along with very extensive needs for transempirical “on-the-spot information” so that the basic helplessness associated with anonymous, inexpressive people and environments can (potentially) be reduced.

5.3 More efficient exploitation of given environments

Theoretically, highly developed local-based services could well reduce the need for geographical mobility because individuals are better able to fulfill their needs near their current location: e. g. by exploring thoroughly whether a certain product or service is available within this very neighborhood, city or region (Kjeldskov & Paay 2006).

¹¹ For similar reasons, modern minimalist architecture prefers uniform buildings that provide no hints whether schooling, medical treatment, software production, financial transactions, law counseling or high fashion creation takes place behind their windows and walls.

“A prime example of the power of Point & Find’s manual search was when we tried searching for a particular videogame – it immediately returned a list of results of nearby places that stocked it, and not only big-name stores, but lesser-known smaller games shops in the vicinity that we wouldn’t have otherwise known existed.” (Mike 2010).

By lowering the costs of acquiring information even in highly intransparent environments, individuals are better able to make efficient use of everything their current location has to offer, so that they can reach higher welfare levels with invariant financial means (e. g. by getting informed about shops that offer discount prices).

On the other hand, the same devices facilitate travelling, because they allow procuring information about a new, yet unknown place very efficiently in very short time. Thus, even weekend tourists who just arrived at the city two hours ago find optimal ways to satisfy even highly idiosyncratic needs, and to inform themselves much more rapidly than with conventional city maps, guide books and public posters (Satoh, Hara, Anabuki, Yamamoto & Tamura 2001).

They may especially be prone to profit from collaborative location awareness applications like the “third eye” that allow users to nail stationary messages at specific locations, so that subsequent passers-by can read and react to them. Such messages may hint at a rare plant growing in a garden, a historical building where a famous person has lived and died; they may inform about imminent changes at city square: that cafeteria X will soon close or that a medical center will soon be opened. In addition, they may even trigger exchanges between males and females interested in each other, but too shy to initiate mutual conversation. In short, they may make a boring environment more complex and pregnant with new experiences and options of activity – thus increasing the commitment of individuals to any specific place where they happen to be for any (maybe involuntary) reason (Belzer & Hekkert 2003).

AR devices are also useful in highly entropic environments where specific items are hard to find by manual searching: e. g. in the case of lousy kept libraries where books on the shelves are not ordered in a consistent fashion (Reitmayr & Schmalstieg 2003); or when kitchens are collectively used, so that current cooks don’t know where specific utensils have been placed by preceding users (Bonanni, Lee & Selker 2005).

5.4 Increasing the complexity and multidimensionality of physical environments

AR makes physical environments richer and more multidimensional: e. g. by adding data about the history of a building, the unseen geological composition of a mountain, or the social networks of a specific person.

“As a result, the physical space now contains many more dimensions than before, and while from the phenomenological perspective of the human subject, the ‘old’ geometric dimensions may still have the priority, from the perspective of technology and its social, political, and economic uses, they are no longer more important than any other dimension.” (Manovich 2005).

This notion of increased environmental complexity is vigorously grasped by the project of a “Palimpsest browser” that aims to make available rich information pools stemming from many sources, and spread over many historical time periods in a multimedia fashion (Toews 2009).

Thus, particular places can become the anchor point of innumerable identities and narrations:

“Recently mobile, wireless, and sensing technologies have provided new opportunities to recast historical experience and the participatory interpretation of place. With these technologies, we can begin to integrate a rich layering of imagined narrative onto physical place while responding to the needs and desires of the peripatetic participant engaged in a multiplicity of realities.” (Dav-enport 2005).

To the degree that AR increases the total amount of data an individual has available about an object or a situational condition, the less he or she will be able to give to everything his full attention: thus increasing the variety of alternatives available and the need to be selective by following one’s own preferences.

“The large amount of virtual information that can be displayed, coupled with the presence of a richly complex physical world, creates the potential for clutter. Cluttered displays can overwhelm the user with unneeded information, impacting her ability to perform her tasks effectively. Information filtering means the act of culling the information that can potentially be displayed by identifying and prioritizing what is relevant to a user at a given point in time. The priorities can be based on the user’s tasks, goals, interests, location, or other user context or environmental factors.” (Höllerer & Feiner 2004: 33)

While conventional tourists are likely to get all the same experience of a city by participating at a guided Sightseeing Tour, AR-equipped future tourists will follow far more divergent paths by deciding whether they want to deepen their knowledge about the city history, its modern art exhibition and antique shops or its beer houses and red light quarters (Tang, Biocca & Lim 2004).

While everybody may become absorbed in his own “customized cloud”, the same applications reduce the risk of getting completely lost in it because they open ways for finding others who share same interests and experiences: e .g. another current Louvre visitor eager to discuss Delacroix pictures, or other guests of the same hotel who intend to visit the same event or exposition.

5.5 The “conservative” bias of AR: shifting weight to perpetual and inert objects

All AR applications are constrained by the boundaries of “registration”: the need to define *ex ante* highly specific correlations between the level of real objects and events on the one hand and the virtual data (triggered by these) on the other (Azuma 1997; Mackay 1998; Höllerer & Feiner 2004; Damala, Marchal & Houlier 2007).

Usually, this presupposes the existence of stable objects which can be tagged and to which secondary information is attached (e. g. commentaries on museum pictures, music songs, personalities, restaurants, tourist sceneries and the like). When they are applied to changing environments, they can only grasp changes of few predefined parameters (e. g. in the case of a hockey game where AR applications indicate the current location of the puck).

Endowing such stable “attractors” with additional data means: giving them more weight in the world of viewers, seducing (or even forcing) them to dedicate more of their attention to exactly these stable things.

As human attention is chronically scarce, less of it will remain available for all other environmental objects to which no tags have yet been attached because they have just come into existence (e. g. newborn babies) or “news-breaking” events and developments on which no reliable knowledge has yet been accumulated.

Whenever such new phenomena appear, there will be a tendency either to neglect them or to recode them so that they fit some predetermined features stored in the AR device – thus eliminating everything that is particular to exactly this concrete thing. (For instance: the sight of a newborn may well trigger generalized information of newborns, but no data about exactly this specific child).

An additional conservative bias stems from the fact that the retrieved AR information is likely to refer to the past, so that it may be outdated at the moment of use (Kjeldskov & Paay 2006). For instance, I may not enter a restaurant with many negative user evaluations despite the fact that since a few weeks, a new, far more sophisticated cook has taken over.

Thus, it is no accident that some of the most advanced and successful applications of AR technology have been in realms where very stable structures are the rule: street and highway maps on the one hand and tourist sightseeing and museum guides on the other (Damal, Marchal & Houlier 2007). Investments in such information systems may be too heavy for even keeping pace with changing expositions – not to speak about current artistic performances and events.

Similarly, AR devices in medicine are far more useful in providing visual enhancements of anatomical features than to track fuzzy and unpredictable physiological or psychopathological conditions.

Of course, there may be ever more efficient ways to reduce time lags by allowing “real-time” updating transmission, but there are of course limits that depend on the stream of information available on specific objects. Thus, updates about changing urban traffic jam conditions will follow much shorter intervals than actualized information about restaurants with rather few (reporting) guests.

5.6 Capacities to aggregate and exploit collective knowledge: “Crowdsourcing”

Our everyday life is filled with tiny observations, experiences and judgment that may potentially be useful for other people: the road from X to Y is always jammed on workdays from 7 to 9; Pizza di Mare in Restaurant K has been awful; the new novel of K has been found particularly thrilling, the new CD album of the band Q is barely innovative, tulip flowers bought in the G shop have kept only for two days and Taxi Service H has been found unreliable for the third time in a row. While such unspectacular experiences are usually kept private or communicated only accidentally to some close kind and friends, even the current stationary Internet has radically opened the gate for making them available very easily to a wider anonymous audience: e. g. by posting hotel evaluations on “tripadvisor.com” or book recensions on Amazon.com.

Mobile phone technology provides the basis for much higher developed systems of “crowdsourcing”¹², because

- uploading data is so easy that more people are able and willing to make contributions;
- individuals can deposit their observations and judgments at the very moment of (or shortly after) their occurrence;
- the masses of incoming data can be aggregated constantly without delay, so that they inform about real conditions, events and developments on a Real-Time basis;
- information retrieval is much less cumbersome than on the stationary computer, because it can be made on the spot whenever the need arises: supported by AR location-aware systems.

¹² According to conventional wisdom, this term” has been coined by the Journalist Jeff Howe in his WIRED Article “The Rise of Crowdsourcing” in June 2006. <http://www.wired.com/wired/archive/14.06/crowds.html>

All these features are well illustrated by current traffic-jam information systems, where innumerable car drivers create a data basis that mirrors real current conditions more precisely than any information generated by the police:

“If you've ever been driving down the highway and looked at the Google Maps application on an iPhone to see what traffic is like ahead, you may have wondered where the data behind the green, yellow, and red lines indicating real-time vehicle flow come from. In fact, the data are coming from people just like you: users of smartphones with GPS who, by the very act of driving down the highway, are feeding back information about how fast they're going to Google, which in turn is sending it back to users of its mobile map apps. Which means, of course, that the application itself is crowdsourced--that is, based on the mutual contributions of many users, all of whom are participating in the product, and without whom, the product would be worthless. (Terdiman 2009)

Evidently, such capacities that increase the self-guidance capacities of highly decentralized collectivities can be harnessed to highly problematic purposes: e. g. in the case of *violent riots* when demonstrators use it for evading police forces or for coordinating sudden attacks on unpredictable targets.

In a general sense, the new collaborative AR technologies allow to exploit to a much larger degree the “discretionary resources” of individuals that have hitherto been “wasted”: their “cognitive surplus” in the form of spontaneous subjective reflections and little snips of free time where they can send a short statement to a collective network, thus enriching collective knowledge and culture with no or very little investment of time, effort or money. In combination with Twitter and other highly popular applications, collaborative crowdsourcing systems may well form the basis for a new, hitherto unavailable sphere of human culture: a layer which combines largest numbers of active contributors with astonishing capacities for swift adaptation.¹³

5.7 The “colonization” of individual subjectivity with superindividual knowledge and norms

On most basic levels of everyday perceptions and behavior, individuals are often “lonesome” in the sense that they are not subject to immediate social influences and that they have no *ad hoc* access to interpersonal interactions or to pools of societal knowledge. Thus, we respond with “spontaneous” emotions to the sight of art works or the hearing of music, and we decide “intuitively” when selecting specific items at the grocery store or when choosing our vocation, marriage partner or habitation.

By emancipating individuals from their ascriptive ties to local communities and kin, and by multiplying alternative options for choice in all sectors of social life, modern society has increased this sphere where individuals have to rely on such internal guidance.

Of course, it is well known that even the most intimate decisions and behavioral patterns (e. g. in sexual activities) are deeply shaped by suprapersonal factors like social norms and cultural traditions. However, all these conformities do not impact by immediate external pressures, but indirectly by previous internalization. In other words, the more an individual acts alone, unobserved and unsanctioned by others, the more his or her conformity with society and culture depends on antecedent processes of socialization and education. The regularities governing my morning toilet, dressing and breakfasting are

¹³ It is important to recognize that all these upward and downward flows can be enacted without any intermediary actors: not individuals has to be embedded in any social group or organization in order to have access to these data pools: neither for uploads nor downloads.

habits acquired at very early ages, and the knowledge needed to enjoy a good novel or to decipher a sophisticated scientific paper derives from my previous professional education and experiences.

Of course, we all know how incapable such inner directions are for guiding us in all our choices and in solving new kinds of problems. For such cases, we use to tap various resources provided by our social or cultural capital: e. g. interaction partners who can be asked for advice, or instruction books where we can find a specific information. However, such resources are usually limited by their clumsiness: the person who knows best cannot be reached, and the encyclopedia where the needed information could be found is back at home, not at my disposal here and now.

Evidently, recent technological developments have changed radically these conditions. By using the Internet and the mobile phone, I have much extended possibilities for engaging into interaction and for retrieving information at my fingertips: irrespective of location and time. "Augmented reality" is only a more radical extension of this longer-term trend: providing individuals with an ubiquitous and perennial capacity to mobilize collectivized information. This implies that a much larger sphere of my total behavior, thinking and cognizing may potentially become influenced (or even governed) by supraindividual socio-cultural factors.

Thus, AR increases the degree to which human beings a truly "social" and "cultural" entities permeated by collective influences even in their most private intimate thoughts and emotions. While Sigmund Freud believed that the representation of society in the individual was restricted to the "super-ego", we could now say that this representation is becoming ubiquitous, because in every single moment we consult such external knowledge, we reduce the scope of our subjectivity by subordinating ourselves to supraindividual guidance.

As an example, we can look at the impact of electronic "museum guides" as they are increasingly distributed to tourist visitors in all common languages. Before such devices have been available, looking at an art picture usually meant: to abandon oneself to spontaneous inner impressions, thoughts and emotions as they were triggered by the sight. Today, such subjective reflections may be curtailed or even eliminated by listening to the verbal commentaries as they are presented by the virtual guide.

Evidently, such superindividual knowledge sources can be most influential when the information conveyed by subjective sensory perceptions is highly indeterminate and diffuse. For instance electronic guides in art galleries will influence visitors more in the case of abstract paintings than representational pictures, because the former convey less intrinsic meaning (Gehlen 1986), so that there is more insecurity about their interpretation.

Many people may feel better when they can substitute diffuse inner intuitions with precise knowledge (e. g. about the significance of the picture in art history and the life and death of its producer), and some may also profit by learning to what features they should direct their attention – but its unquestionable that weights are shifting from nonverbal subjective experience to intersubjective verbal communication – thus consolidating the *hegemony of language* over all other creative human manifestations.

The possibilities for AR increase the degree to which perceived things and persons are decoded in terms of generalized (mostly quantifiable) dimensions (e. g. a person in terms of his/her number of Facebook friends or restaurant in categories used for its evaluations). Thus, AR promotes the long-term development diagnosed by Walter Benjamin in his famous essay "The Work of Art in the Age of mechanical reproduction": the tendency to see objects of any sort no longer as unique particulars, but as specimens of a category of standardized (and thus fully reproducible and replaceable) things:

"Unmistakably, reproduction as offered by picture magazines and newsreels differs from the image seen by the unarmed eye. Uniqueness and permanence are as closely linked in the latter as are transitoriness and reproducibility in the former. To pry an object from its shell, to destroy its aura, is the mark of a perception whose "sense of the universal equality of things" has increased

to such a degree that it extracts it even from a unique object by means of reproduction. This is manifested in the field of perception what in the theoretical sphere is noticeable in the increasing importance of statistics.” (Benjamin 1935: 4)

This increasing weight of supraindividual knowledge may well have the effect that the purely *subjective* components of experience may become increasingly marginalized- or even discredited to the degree that they lose all relevance not only in contexts of social interaction, but also in the psychological functioning of individuals themselves. A new form of “self-estrangement” may emerge: stemming from the conviction that mere subjective experiences are devoid of any meaning and significance because they cannot be part of this inter- and supraindividual sphere

5.8 Facilitating perfect and extensive elite-guided domination

Producing AR devices means: to implement centralized decisions about the type of data and information presented (or not presented) to all users who apply such devices subsequently in their everyday life. Even when concrete contents are determined by many different users (in the case of “collaborative tagging” and other crowdsourced systems), there are first of all some few strategists and designers who decide about the basic structure as well as all the details of the “mixed reality” they produce: the degree to which the invisible shall be made visible, and the precise form in which this should be done (Lamantia 2009).

Of course, such decisions are always guided by the ideas, ideologies, values and preferences of these same producers. Thus, AR technologies can be seen as vehicles for transporting such patterns from elites to broader populations.

“... the information in AR systems is mostly created by professional content providers like institutions and organizations. The virtual information space of AR systems is socially dead in so far as ‘ordinary’ users cannot leave explicit traces (e.g., annotations) or implicit traces of usage and other behavior. This makes AR information spaces non-dynamic, nonsocial and non-communicatory.” (Persson, Espinoza & Cacciatore 2001).

As media of socio-cultural domination, they have the potential to be more reliable and effective (or even “totalitarian”) than most previous media of the same sort have ever been, because they reach down to the most basic levels of subjective senso-motoric processes and the most elementary contexts of everyday human life.

In bureaucracies and many other work places, individuals are obliged to follow strictly rather complex sets of rules that are explicated in statutes, guide books, instruction manuals, codes of practice etc. Under conventional conditions, observing such rules reliably presupposes that they either have all been learned by heart (in antecedent processes of socialization), or that the written compendia are regularly consulted. In many cases, prior socialization is insufficient (e. g. in the case of new, still inexperienced workers) or there is no time for consultations (e. g. in sudden emergency cases as they occur in damaged airplanes or on surgery tables). In addition, errors may occur because previously learnt (or read) rules may not be adequately remembered.

In all such conditions AR devices can be helpful by making the needed rules available “on the spot”: e. g. as virtual projections blended into the same visual field on which operators have to focus for dealing with the imminent problem, so that operative processes remain undisturbed. Especially in the case of technical manipulation, bringing the rules quite to the physical appliance means that they often can be symbolically simplified, because elaborated wordings can be substituted by pictographic signs. For instance, the instruction “now press the button AB three times” may be replaced by a green 3X overlay-

ing the respective button. Certainly, such overlays are particularly useful for purposes of instruction: e. g. when new employees have to be trained or when new rules shall be implemented.

By lowering the level of required prequalification, even highly complex types of rule oriented behavior can be extended to broader segments of the working population, and by reducing the need to oscillate attention forth and back between instruction manuals and operative procedures, the speed as well as the reliability of rule implementation can be increased. In realm of organized work, AR may well insert itself into the long-run developments of “Taylorization” during which the need for personal qualifications is continually lowered because internalized skills are substituted by externalized rules and social controls.

Among many other things, this would imply that

- 1) investments in socialization and education lose value because they are no longer needed for many activities and roles;
- 2) senior employees can no longer trade their larger experience for higher income because younger people can easily reach the same level of competence;
- 3) job rotation is facilitated because AR devices ease the learning of new patterns of behavior and roles;
- 4) more workers are exposed to job insecurity and dismissal insofar as they can more easily be replaced.

5.9 The new pervasive roles of reading and writing

As we know from early history, writing and reading was first an elitist competence practiced only by cultural minorities like lawyers or priests. Only with the printing press, written texts became more widely available: so that educational policy since the 18th century was directed toward the alphabetization of the total population in order to secure that everybody could participate in all relevant sectors social life.

However, the relevance of written culture in everyday life is still highly restricted by the fact that neither books and encyclopedias nor journals and newspapers were normally available “on the spot” – and most of them of course don’t contain information helpful for solving current problems and accomplishing highly particular tasks (Geser 2006). Seen in this wider perspective, AR is just another stage in this long term evolution of increasing pervasiveness of writing in human life – similarly to Email and SMS that have expanded the reach of writing to levels of highly informal interpersonal communication.

To the degree that AR devices are based on written texts (e. g. by informing me about the quality of a restaurant as I pass it by), it is of course essential that people are technically able to read. Similarly, writing is essential for feeding one’s own experiences and judgment into the pools of crowdsourced information.

Insofar as reading and writing becomes more essential for an efficient execution of almost all daily tasks, AR can be seen as a mechanism for amplifying social inequalities related to skills or writing and reading: thus marginalizing more than ever not only “genuine” unschooled analphabets in poor Southern countries, but also school drop outs (“functional analphabets”) in our own societies.¹⁴

¹⁴ Of course, such skills will be less needed when oral interfaces between digital equipment and human beings will be implemented: voice recognition software for feeding in data, and voice editing software for delivering information.

5.10 AR as a substitute for interpersonal interaction

Many modern technologies reduce the need for interpersonal interaction, because they empower individuals to get a desired product or service without engaging in any social communication (Mettler-Meibohm 1990). Thus, self-service restaurants, ticket machines and cash dispensers allow for anonymous economic transactions, modern household equipment has eliminated the need for cooperative cooking and washing, and lonesome evenings in front of TV sets have substituted social gatherings in opera houses, theatres and varietés (Geser 1992).

The Internet has accelerated this *“desocialization of everyday life”* by providing means for paying bills, subscribing to political petitions and searching for lifetime partners without leaving home, and for procuring garments, books and DVD’s without visiting respective outlets in the city. In the office, computer applications have effected a *thinning out of primary interpersonal interactions* because any relevant information can be more readily found on the common server – even when well informed colleagues are only a few inches away (Koch 1981).

In a similar vein, the supraindividual information made available by AR devices may be a substitute for information that has hitherto been gathered by interpersonal communication - irrespective of whether it has been generated by centralized design or by decentralized (*“crowdsourced”*) collaboration.

Thus, tourists will have fewer reasons to ask indigenes about the way to the local opera or railway station, because they can retrieve all such information from their electronic guides. And friends visiting a museum together will engage in less mutual talk when each of them is absorbed by the commentaries delivered by the electronic guide.

“Gone are the days of being on a business trip and having to rely on the concierge for restaurant suggestions or the wait staff for meal recommendations.” (Sherman 2010).

In addition, giving information becomes more risky because the receiver has more possibilities to check whether it is right or wrong:

“How much harder will it be to...well...be wrong? When anything you say or about too, can be near-instantly checked or cross-checked against multiple sources?” (Wrobel 2009).

As a consequence, interpersonal contacts may lose the function of exchanging information and shrink to topics and items that are not covered by AR devices because they are particularistic to a specific situation (e. g. the current weather conditions or instant availability of free restaurant tables), or because they have to do with personal opinions and emotions:

“Imagine if, for example, anything you say can dynamically link to any Wikipedia article or definition. We would no longer have to exchange much pre-existing knowledge in order to explain ourselves, we would more directly be communicating ideas and opinions rather than knowledge used to back them up.” (Wrobel 2009).

5.11 Tighter coordination and collaboration over distance

The visual patterns presented by AR applications can easily be transmitted to any collaborators at any other places, so that very tight cooperation is possible irrespective of geographical distance. For instance, remote collaborators can easily be added to the team: making larger work teams possible than under conventional conditions where the smallness of an object sets limits to the number of workers who are near enough to participate in its manipulation. In the military, generals can potentially participate in very specific (but crucial) tactical operations in the field, and medical ambulances can contact experienced hospital doctors in highly difficult emergency cases:

„Out in the field, emergency medicine personnel could assess a situation quicker with wearable sensing and AR technology. They could apply the wearable sensors to the patient and would, from then on, be able to check the patient’s status through AR glasses, literally at one glance. Also, a remote expert at a distant hospital could be brought into the loop and communicate with the field worker via the AR system, seeing through camera feeds what the field worker is seeing, which could be important to prepare an imminent operation at the hospital.“ (Höllner & Feiner 2004.

Thus, AR helps to intensify vertical collaboration across different levels of hierarchy: enabling higher ranking personnel to exert tighter control on operative levels - as well as to become more empathic and responsive to their subordinates and their environmental conditions.

6. Augmenting persons: the shift from communicative to observational social relations

There are two basic ways how to get knowledge about another person: communication and observation. In the *communicative* mode, I see the person as an “ALTER EGO”: a subject like myself endowed with the capacity to disclose self-related information according to his/her own choosing: e. g. by trying to convey a certain impression of him- or herself or by just answering questions (e. g. in a judicial interrogation). Of course, this always implies that disclosures are exposed to distortion, lying and pretending, and that they vary significantly according to time, location, interaction partners and environmental conditions. In the *observational* mode, the other person is seen as an *object*: endowed with a body that constantly emits information by his mere appearance, locomotion and (nonverbal and verbal) behavior, and who permanently leaves traces of past activities (e. g. records about phone call connections or credit card transactions).

All face-to-face-interaction is characterized by the regularity that these two modes are tightly intertwined. As an interaction partner, I focus on the “cues given” by my partner while speaking or emitting intentional gestures, and as an observer, I’m attentive to the “cues given off”: e. g. spontaneous mimic and gestures he doesn’t know about and has not under his control (Goffman 1959: 7). At the same time, there are strong norms for avoiding asymmetries that could potentially disturb friendly relations by discouraging the use of fans, black sunglasses, one-way mirrors, spyglasses etc. All such devices are seen as being inordinately “intrusive” by violating the careful equilibrium between privacy and interpersonal harmony that has constantly to be preserved (Goffman 1963a).

Technical communication media have amplified both modes and made them more independent from each other. On the one hand, telephone talks and email traffic allow pure communication without any observation (because only intentional cues are transmitted), and on the other hand, surveillance technologies like CCTV cameras and Website lurking allow pure observation without communication: the unilateral accumulation of information without informing the targeted persons and without giving them any opportunity for reaction. Thus, dramatic inequalities in the chances to observe and the vulnerabilities to be observed are created: disparities that build on preexisting asymmetries of power, money and social status (e. g. in the relationship between employers or employed or between citizen and government), but that tend to be amplified by the new technological means (McNamee 2005; Bennett & Crowe 2005).

In the course of socio-cultural evolution, observational relations take increasingly the lead, because they can be expanded without limits: e. g. by using the ever expanding means of high-tech surveillance.

By contrast, communicative relations remain a scarce good, because they require a coordinated reciprocal attention by both (or several) partners.

Since George Orwell's seminal novel "1984", it has become a common sense notion that such developments collide with our occidental notions of individual dignity and freedom, because personal autonomy is very much based on the preservation of privacy: a "sanctuary" where individuals can be certain that they are not exposed to involuntary observation.

While the totalitarian regimes of the early 20th century have illustrated the dangers of centralized surveillance by one "BIG Brother", the more recent digital technologies bring along the perspective of highly decentralized surveillance networks where privacy is threatened by *innumerable little or half-grown brothers*: from municipalities and private firms operating CCTV cameras to Paparazzis and stalkers with spyglasses, hackers smuggling Trojans on personal computers and personnel managers sifting the web for getting detailed information about applicants for a job.

The days are gone when human privacy was mainly guaranteed by "natural ignorance" caused by mere technical deficiencies (e. g. by the impossibility to track individuals on the move), or by the physical separation of different role settings (e. g. family, school and work). Instead, modern privacy has to be built on the shaky ground of an "artificial ignorance" based on legal restrictions in the application of high-tech surveillance (data protection) or on technical countermeasures like jamming transmitters, firewalls and encryption.

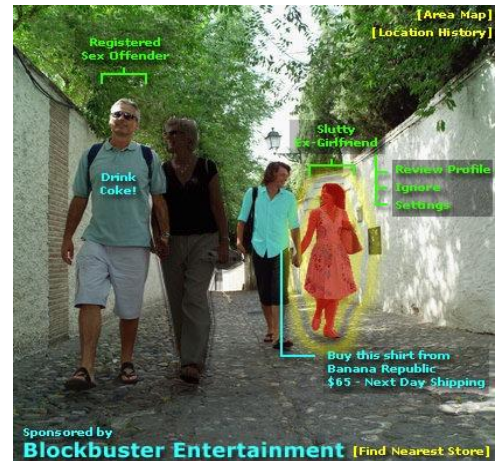
Augmented Reality provides additional capacities to extend surveillance by tagging human beings in the same way a buildings, restaurants or art objects on an exhibition. Thus, location-based geotracking applications not only allow to follow the movements of specific individuals in space, but also to search for individuals with specific characteristics within a specific environment. The ianous-faced implications of such devices is vividly illustrated by the Sex offender software released by "govision2020" in 2009:

"Offender Locator¹⁵ has three ways to let you know if an offender lives nearby: It can use GPS to detect your current location, you can enter an address from your iPhone address book or you can manually enter a street address. Once selected, the app displays a list of offenders sorted by distance from your location. The Lite version limits the list to 10 names. From there you can click on a name and Offender Locator will display an image of the subject, street address, date of birth, race, height and weight, hair and eye color, and a short sentence describing the type of sexual offense. There is a mapping option, but it is lacking, as you can't drag the map around or touch a pin on the map to get more details." (Smithivas 2009)."

¹⁵ <http://www.govision2020.com/OffenderLocator.html>

In the near future, we may live up to a society where everybody has access to a centralized face-recognition databank which allows him to verify my identity from directing his mobile camera at my head – and link this identity to the Internet where he finds all my personal information.

“Then there is AugmentedID, a facial recognition technology using algorithms, from Polar Rose, a startup that delivers photo-tagging tools for Flickr. With this application, you can hold your phone up to a person's face and see their online profile, contact info, social networking links, and any other information they've chosen to share.”¹⁶



Evidently, investigative police work will experience spectacular improvements. Facial, voiceprint, and other biometric recognition data of known criminals will certainly allow officers to identify wanted subjects merely by observing people on the street. Speaker-recognition technology, under development, will give investigators the ability to accurately match voices against known criminals (Jin & Waibel 2000). With advanced optics, investigators could lip-read from great distances in situations where listening devices would prove impractical (Meier et. al. 2002). As we know from many other previous technological innovations, the spread of such devices to a much larger sphere of private users cannot be avoided.

While I may feel an urgent need to know on the spot whether the boy friend of my daughter has a history of drug dependence, my new business partner is near bankruptcy or my office colleague is on probation, such information is of course stigmatizing and lends itself to most oppressive forms of ostracism and discrimination.

As Erving Goffman has analyzed so thoroughly, civil society sets individuals under pressure to present themselves carefully in the public: by diligent dressing, haircuts, deodorants and cosmetic procedures. This “careful personal appearance” is a powerful signal indicating that an individual is capable to control himself – a very fundamental competence which provides the essential ground for almost all other, more specific qualifications (Goffman 1963a).

As discussed in his book “Stigma” (Goffman 1963b), some individuals are not able to conform to such norms of normality because of various visible (or audible) deficiencies on the physical level. He makes a strong difference between such “stigmatized” persons deviating visibly and the merely “stigmatizable” persons who possess a handicap not visible to others: e. g. a prison record or an imminent business insolvency.

Of course, this whole concept has to be fundamentally redefined when it includes AR information not visible by the senses: such as facts about earlier life or current social affiliations. In fact, everybody who is “stigmatizable” may become readily “stigmatized” without having any control over personal disclosure. *Most disturbingly, I will no longer be sure what others know about my person.* Thus, I have to be careful to pretend anything that is not true because anybody is potentially able to falsify this information at any time. In fact, “understatement” will be a better strategy because I may profit when others are surprised to gain a more positive impression about me when consulting the Net than when interacting with me in person.

¹⁶http://www.readwriteweb.com/archives/prepare_yourselves_augmented_reality_hype_on_the_r.php

In an even wider (still Goffmanian) perspective, it might be argued that the basic division between “front stage” and “back stage” can no longer be neatly maintained.

In most spheres of everyday life, we tend to base our judgments and decisions very strongly on spontaneous sensory impressions. Thus, we initiate contact with a proximate female because she looks attractive, and we enter a restaurant because it looks clean and inviting from the street. Of course, we know that such decisions can be awfully flawed because the visible exterior may convey quite erroneous information. More than that, we know that individuals as well as establishments engage in “impression management”: by building up an attractive showside that is systematically at variance with the reality it tries to pretend. For instance, female attractiveness may result just from heavy cosmetic manipulations; and restaurants spending their money for luxury front entries may have no means left to modernize their kitchen.

AR can take weight from such unduly reliance on misleading primary impressions by adding information about less visible aspects, but more essential attributes of an individual or an establishment, e. g. about evaluations they have received from authoritative institutions, or about their past behavior as it has been experienced by many other people.

In a very general sense, AR applications widen the pool of information on which judgments about individual or social actors can be based, and they may shift attention somewhat away from highly subjective primary impressions in favor of features that are invisible for intrinsic reasons (e. g. the recruitment policy or the ecological standards of a business firm) and better founded collective judgments. As a consequence, even persons with an unfavorable outside appearance may get more chances of being accepted, and all of them may reduce their investments in mere “impression management” – knowing that their fate now depends more on nonphysical aspects of their “public appearance”: e.g. their prominence on Facebook, Google Scholar or any other revealing¹⁷ sites.

On the level of *informal networks*, it is fascinating to see how the application of person-augmenting devices is regulated by the two most basic and ever countervailing driving forces in social life: the urge to get more information about others and the need to keep control over one’s own disclosures.

A ready compromise between these two tendencies is offered by applications that allow all participants to regulate their visibility vis-à-vis various others:

“Unlike other location-based applications¹⁸, echoecho¹⁹ doesn't force you to constantly broadcast your own location. Instead, the application takes the opposite route. Instead of telling people where you are, you ask others where they are. Whenever you request somebody's location, your friend has the option to completely ignore your request. At the same time, if somebody responds to your request, that person will also be able to see your own location.”²⁰

In the future, highly complex systems of “personal digital transparency regulation” may emerge which allow individuals to determine who has access to what data (about their person, their biography and their social networks) at what time and within what geographical regions or situational conditions.

¹⁷ www.tripadvisor.com

¹⁸ like stalger <http://www.stalger.com/>

¹⁹ <http://echoecho.me/Info/PC/>

²⁰ Lardinois Federic Echoecho: Locating Your Friends Made Easy. ReadWriteWeb January 25, 2010 11:00 AM http://www.readwriteweb.com/archives/echoecho_locate_friends_permission_based_geolocation_app.php

“In general, persons may be comfortable releasing their precise tracking information to a small, select group of friends and colleagues; may be willing to allow others to know their location with less accuracy (e.g. that they are in a specific room or building), and still others with much less accuracy (e.g., that they are in a particular city); and may perhaps be intentionally willing to deceive yet others. Similarly, the recipient of this information may also be more or less interested in the accuracy with which it is provided, if only to suppress some or all of it to decrease the clutter in their own virtual environment that would be produced by displaying it all.” (Feiner 1999: 146).

For instance, when participating at a scientific congress or work shop, academic participants may be prone to present themselves to all other members “professionally naked”: by giving them full access to information about their curriculum, their publication lists, research interests and academic affiliations (but not about their private family matters). Such regulated transparencies would certainly be functional for shortening the cumbersome processes of “learning about each other” (before any more substantial communication can set in), and they would catalyze the creation of common ground of successful multilateral association.

7. Conclusions

The evolution of computer technology can be described as an ever improving adaptation of digital interfaces to the body and mind of human beings. Beginning with IBM’s mainframe computers of the 1960ies hidden in air-conditioned compounds and controlled by almighty operators, we have experienced the rise of stationary Personal Computers that brought computing and storage and communication capacity to everybody on his desk. The PC then was followed by the notebook which made the same empowerments available while on the move and across a manifold of different locations and social roles. Combined with mobile phone technology, we currently see the worldwide rise of “smart phones”: extremely and unobtrusive handsets that provide an ever growing abundance of functionalities right at our fingertips: irrespective of time, place and situational conditions.

By venturing the prediction that “Augmented Reality” will soon make a spectacular career, this prophecy is deeply founded in the insight that AR is just a logical continuation of this longer-term trend: by making the capacities of digital technology available not in a virtual realm separated from the Real World, but right within the field of our primary senso-motoric behavior: thus intensifying (instead of weakening) our relationship to Real Things, Real Human Beings and Real Social Entities present at (or near) our current physical location.

Even more than that: the rise of AR is likely to be irresistible because it enhances very fundamental functionalities of the human mind that have ever been involved in any processes of human cognition. Going back to *Edmund Husserl*, we have discovered such procedures in *the basic phenomenological structure of human perception* where sensory impressions are spontaneously amalgamated with “horizons of reference”: with spheres of transempirical knowledge that provide meaning to what I see, hear, smell or touch, and by interpreting my subjective impressions as indicating an “object” that is part of the RealWorld we all share. In a second, “Gestaltpsychological” perspective, AR can also be understood as an enhancement of deeply anchored laws of human cognition: by amplifying our spontaneous capacities to carry order into noisy empirical data and to simplify environmental complexity so that it can be subsumed under well-known concepts and forms.

Evidently, this evolution will only be ended with interfaces that allow us to control inputs with mere gestures and oral speech, and to receive outputs by totally unobtrusive devices like corneal or cochlear implants. However, even the currently existing applications (like the Layar browser) belong to the most ergonomic (and psychonomic) interfaces ever been known: allowing to exploit the immense universe of digital knowledge without cost and delay for innumerable problem solving tasks and tiny everyday needs.

It is this penetration of the digital sphere into the lower and lowest realms of informal human cognition and behavior that gives rise to many utopian as well as dystopian perspectives. Evidently, a new level of “individual empowerment” is achieved when overlaid digital instruction devices help to set a newly bought complex machinery into motion, or when one is able to know the quality of a restaurant by simply pointing with the camera at its entrance. When the targets are human beings, however, there is a basic antinomy because A’s *empowerment* to “see” B’s identity, biography or Facebook entries is compensated by B’s correlative *disempowerment*: his inability to hide such information from A. While the shift from communicative to observational social relations is strongly going on in the citizen-government or employer-employee relationship as well as in the realm of informal interpersonal relations, new devices of reciprocal data control have to be established in order to keep an equilibrium between the advantages to observe others and the needs to preserve privacy and to control autonomously one’s own disclosure.

References

- Anisman,-Reiner Victoria 2009** Google Latitude. Google's New Social Networking Technology Uses GPS and Mobile Phones. Suite101.com, Feb. 5. http://satellitetechnologygps.suite101.com/article.cfm/google_latitude
- Anthes, Emily 2009** Cell Phones will soon be able to sense our environment and its pollutants. Seedmagazine May 1 2009. http://seedmagazine.com/content/article/the_tricorder_arrives/
- Azuma, R. T. 1997** A survey of augmented reality. Presence Teleoperators and Virtual Environments 6(4), 355–385.
- Bardwell Christine 2010** Augmented reality is now: the top three uses of AR live in retail today. Ovum <http://www.ovum.com/news/euronews.asp?id=8371>
- Barrett Brian 2010** The Facial Recognition Augmented Reality App That Could Revolutionize Stalking. GIZMODO, Febr. 15th. <http://gizmodo.com/5472251/the-facial-recognition-augmented-reality-app-that-could-revolutionize-stalking>
- Belzer, R. & Hekkert, P. 2003** The Third Eye: Increasing Awareness with Extended Communication. <http://studiolab.io.tudelft.nl/static/gems/hekkert/Thethirdeye.pdf>
- Benjamin, Walter 1935** The Work of Art in the Age of Mechanical Reproduction. (originally published in German in the Zeitschrift für Sozialforschung 1935). <http://design.wishiewashie.com/HT5/WalterBenjaminTheWorkofArt.pdf>
- Bennett, Colin J. & Crowe, Lori 2005** Location-based Services and the Surveillance of Mobility. An analysis of Privacy Risks in Canada. A Report to the Office of the Privacy Commissioner of Canada under the 2004-2005 Contributions Programs, June.
- Berry, R. A. 2008** Hyper-Augmented Reality: Looking at AR through some old postmodern goggles". ISEA 2008: International Symposium on Electronic Art 25 July - 3 August 2008, Singapore Management University, Singapore, 1-3.
- Billinghurst, M., Kato, H., Poupyrev, I. 2001** The MagicBook: Transitional AR Interface. Computers and Graphics, November, 745-753.
- Billinghurst Mark & Kato Hirokazu 2002** Collaborative augmented reality Communications of the ACM a Volume 45 , Issue 7 (July).
- Bimber, Oliver & Rashkar, Ramesh 2004** Spatial Augmented Reality, *Proceedings of the 3rd IEEE/ACM International Symposium on Mixed and Augmented Reality*.
- Biocca, Frank, Jannick Rolland, Plantegenest Geraud, Harms Chad, Reddy, Chandan, Owen, Charles, Weimin Mou, & Tang, Arthur 2009** Approaches to the Design and Measurement of Social and Information Awareness in Augmented Reality Systems. (*Invited Paper*), Proceedings of 10th International Conference on Human-Computer Interaction, Crete, Greece, June 22-27.
- Bonanni, L., Lee, C.H., & Selker, T. 2005** Attention-Based Design of Augmented Reality Interfaces. Short paper in the Extended Abstracts of Computer Human Interaction (CHI),Portland OR. <http://web.media.mit.edu/~jackylee/publication/lbr-484-bonanni.pdf>
- Buxton, W. 1997** Living in Augmented Reality: Ubiquitous Media and Reactive Environments. In K. Finn, A. Sellen & S. Wilber (Eds.). Video Mediated Communication. Hillsdale, N.J.: Erlbaum, 363-384.
- Caceres Chris 2009** Social Network goes Augmented Reality. Popular Japanese augmented reality application, Sekai Camera lets you comment on anything around you. Vator News December 22th. <http://vator.tv/news/show/2009-12-21-social-networking-goes-augmented-reality>
- Chen, Brian X. 2009** If You are not Seeing Data, You're not seeing. WIRED August 25. <http://www.wired.com/gadgetlab/2009/08/augmented-reality/>
- Chernenko Evgenia 2005** Augmented Reality Concept in the Design of Innovative Working Environment University of Joensuu. ftp://cs.joensuu.fi/pub/Theses/2005_MSc_Chernenko_Evgenia.pdf
- Cowper Thomas J & Buerger Michael E. 2003** Improving Our View of the World: Police and Augmented Reality Technology. FBI, Futures Working group 2003. <http://www.fbi.gov/publications/realitytech/realitytech.pdf>
- Cowper Thomas 2004** Improving the view of the world; law enforcement and augmented reality technology. FBI Law Enforcement Bulletin, Jan 1. <http://www.fbi.gov/publications/realitytech/realitytech.pdf>
- Damala, A., Houlier, P. & Marchal, I. 2007** Merging Augmented Reality Based Features in Mobile Multimedia Museum Guides, Anticipating the Future of the Cultural Past, CIPA Conference, 1-6 October, Athens, Greece, 259-264.
- Davenport Glorianna 2005** When Place Becomes Character: a critical framing of place for mobile and situated narratives, MIT Media Lab Cambridge Mass. <http://mf.media.mit.edu/pubs/other/CharacterPlace.pdf>
- Della Favera, Jorge Carlos, Malmann Medeiros & Marco André 2007** Gestalt psychology and the recognition of complex sedimentary structures in geology Revista Brasileira de Geociências 37(4): 841-847, dezembro de 2007.
- Eaton Kit 2010** Google Buzz:Are You at Work? How About a \$.99 Big Mac From McDonald's, Three Blocks Away?" FAST COMPANY Febr. 10th 2010. <http://www.fastcompany.com/1545754/google-buzz-social-networking-realtime-advertising-personalized-location-aware-ads>
- Feiner, Steven K.1999** The Importance of Being Mobile. Some social Consequences of Wearable Augmented Reality systems. Proceedings of IWAR '99 (International Workshop on Augmented Reality), San Francisco, CA, October 20–21, 145–148.
- Gehlen, Arnold 1986** Zeitbilder. Zur Soziologie und Ästhetik der modernen Malerei, Frankfurt a.M.
- Geser Hans 1992** Soziales Handeln in der individualisierten Gesellschaft (in: "Kommunikation", Nr. 57, August:3-14).

- Geser Hans 2006** From printed to „wikified“ encyclopaedias. Sociological Aspects of an Incipient cultural revolution. In: Sociology in Switzerland. Online Publications, Zürich 2006 http://socio.ch/intcom/t_hgeser16.pdf
- Geser Hans 2007** Me, Myself and my Avatar. Some microsociological reflections on “Second Life”. In: Sociology in Switzerland. Towards Cybersociety and Vireal Social Relations. Online Publications, Zürich, April 2007. http://socio.ch/intcom/t_hgeser17.pdf
- Giles, Jim 2009** Augmented reality system lets you see through walls. New Scientist Tech, Oct 23th <http://www.newscientist.com/article/dn18036-augmented-reality-system-lets-you-see-through-walls.html>
- Goffman, Erving 1959** The Presentation of Self in Everyday Life. Garden City, New York: Doubleday.
- Goffman Erving 1963a:** Behavior in Public Places: Notes on the Social Organization of Gatherings, The Free Press. New York.
- Goffman, Erving 1963b:** Stigma: Notes on the Management of Spoiled Identity. Prentice-Hall. N. J. Englewood Cliffs J. J.
- Hansen, Mark 2006** Bodies in Code: Interfaces with Digital Media. New York: Routledge, 2006.
- Höllerer, Tobias H. & Feiner Steven K. 2004** Mobile Augmented Reality. In: Karimi H and Hammad A. (eds.) Telegeoinformatics. location-Based Computing and Services. Taylor & Francis Books Ltd 01/2004).
- Howe Jeff 2006** The Rise of Crowdsourcing” WIRED, Issue 14.06 June 2006. <http://www.wired.com/wired/archive/14.06/crowds.html>
- Husserl, Edmund 1973** Cartesian meditations and the Paris lectures. Husserliana Volume I edited by S. Strasser 1973.
- Q. Jin & A. Waibel 2000** Applications of LDA to Speaker Recognition, presented at the International Conference on Speech and Language Processing, Beijing, China, October. <http://www.is.cs.cmu.edu/mie/>
- Johnson Brian R. 2002** Virtuality and Place: The relationship between place, computation, and experience. University of Washington, Seattle. <http://faculty.washington.edu/bri/Publications/ACADIA02.PDF>
- Kangas, Kari & Rönning, Juha 2002** Using mobile code to create ubiquitous augmented reality, *Wireless Networks*, Volume 8 , Issue 2/3 March-May.
- Kjeldskov Jesper, Paay Jeni Kjeldskov J. & Paay J. 2006** Augmenting the City: The Design of a Context-Aware Mobile Web Site. Gain: AIGA Journal of Business and Design (4).
- Kiyokawa, K., Takemura, H., Yokoya, N. 2000** "SeamlessDesign for 3D Object Creation," IEEE MultiMedia, ICMCS '99 Special Issue, Vol.7, No.1, 22-33, <http://www.lab.ime.cmc.osaka-u.ac.jp/~kiyo/cr/kiyokawa-2000-03-IEEE-Multimedia/kiyokawa-2000-03-IEEE-Multimedia.pdf>
- Kobie, Nicole 2009** Nokia launches beta of 'Point & Find' system for mobile phones. ITPRO April 2. <http://www.itpro.co.uk/610402/nokias-point-find-uses-camera-phone-for-search>
- Koch, R. 1981** Aktuelle Veränderungstendenzen kaufmännischer Sachbearbeitertätigkeiten durch die Anwendung elektronischer Datenverarbeitung (EDV) in der Industrieverwaltung. In: Rationalisierung der Büroarbeit und kaufmännische Berufsausbildung. (U. Böhm, W. Littek and F. Ortman). Frankfurt/New York, Campus, 118-134.
- Koffka K. 1935** Principles of Gestalt Psychology. New York, Harcourt Brace.
- Lamantia, Joe 2009** Inside Out: Interaction Design for Augmented Reality. UXmatters August 17th <http://www.uxmatters.com/mt/archives/2009/08/inside-out-interaction-design-for-augmented-reality.php>
- Lehar, S. 2004** Gestalt Isomorphism and the Primacy of Subjective Conscious Experience: A Gestalt Bubble Model. *Behavioral Brain Sciences*, 26(4), 375-444.
- Mackay, Wendy E. 1998** Augmented Reality: Linking real and virtual worlds. A new paradigm for interacting with computers. In *Proceedings of AVI'98, ACM Conference on Advanced Visual Interfaces*, New York: ACM Press. <http://www.lri.fr/~mackay/pdf/AVI98.AugmentedReality.pdf>
- Manovich, Lev 2001** The Language of New Media. Massachusetts: Institute of Technology.
- Manovich, Lev 2005** The Poetics of Augmented Space http://www.manovich.net/DOCS/Augmented_2005.doc
- Mcnamee A. 2005** Ethical Issues arising from the Real Time Tracking and Monitoring of People Using GPS-based Location Services. Bachelor Thesis, University of Wollongong. <http://ro.uow.edu.au/thesesinfo/4>
- Meier, U. R. Stiefelhagen, J. Yang, & A. Waibel 2000** Towards Unrestricted Lipreading, *International Journal of Pattern Recognition and Artificial Intelligence* 14, No. 5: 571-785; retrieved February 16, from <http://www.is.cs.cmu.edu/mie/>
- Mettler-Meibom, Barbara 1990** Wie kommt es zur Zerstörung zwischenmenschlicher Kommunikation? (in: Rammert, Werner (Hrsg.) *Computerwelten - Alltagswelten*, Westdeutscher Verlag Opladen, 65-89).
- Mike, 2010** Nokia Point & Find real-world pilot in UK – hands-on report (part two) *Nokia Conversations* Febr. 10, <http://conversations.nokia.com/2010/02/10/nokia-point-find-real-world-pilot-in-uk-hands-on-report-part-two/>
- Nagao, Katashi and Jun, Rekimoto 1996** Agent Augmented Reality: A Software Agent Meets the Real World, *Proceedings of the Second International Conference on Multi-Agent Systems*, pp. 228-235,.
- Norman, D. 1998** The Invisible Computer: Why Good Products Can Fail, the Personal Computer is SoComplex, and Information Appliances Are the Solution. Cambridge, Mass. MIT Press.
- Pedersen, E.R., McCall, K., Moran, T.P.& Halasz, F.G. 1993** Tivoli: An Electronic Whiteboard for Informal Workgroup Meetings. In *Proceedings of Human Factors in Computing Systems (InterCHI 93)* ACM Press, pp. 391-398.
- Persson, Per, Fredrik Espinoza & Elenor Cacciatore 2001** GeoNotes: Social Enhancement of Physical Space. Social Mobile Computing Group, SICS, Kista, Sweden. http://www.sics.se/~espinoza/documents/geonotes_chi_design_expo.pdf

- O'Reilly, Tim & Jennifer Pahlka 2009** The 'Web Squared Era' Forbes.com 09.24.09, 12:19 PM EDT
<http://www.forbes.com/2009/09/23/web-squared-oreilly-technology-breakthroughs-web2point0.html>
- Reitmayr, G. & D. Schmalstieg, D. 2003** Location Based Applications for Mobile Augmented Reality Proc. AUIC2003a, Adelaide, Australia, Feb. Available as technical report [TR-188-2-2002-23](#), Vienna University of Technology.
- Reitmayr, G. & D. Schmalstieg 2004** Collaborative Augmented Reality for Outdoor Navigation and Information Browsing Proc. Symposium Location Based Services and TeleCartography, Vienna, Austria, January, 2004 Available as technical report TR-188-2-2003-28, Vienna University of Technology.
- Satoh, K., Hara, K., Anabuki, M., Yamamoto, H. & Tamura, H. 2001** TOWNWEAR: An outdoor wearable MR system with high-precision registration, in 'Proc. IEEE Virtual Reality 2001', Yokohama, Japan, pp. 210–211.
- Schonfeld Erick 2010** Augmented Reality vs. Virtual Reality. TechCrunch Jan 6th.
<http://techcrunch.com/2010/01/06/augmented-reality-vs-virtual-reality/>
- Sherman, Aliza 2010** How to use location-based Social Networks for Business. WebWorkerDaily Febr 2th.
<http://webworkerdaily.com/2010/02/02/how-to-use-location-based-social-networks-for-business/>
- Smithivas, Mark 2009** Offender Locator tells you if past offender lives nearby. appolicious.posted August 31, 3:21 pm.
<http://www.appolicious.com/articles/407-offender-locator-tells-you-if-past-offender-lives-nearby>
- Stross, Charles. 2009** LOGIN 2009 Keynote: Gaming in the World of 2030. Charlie's Diary. Retrieved August 1, 20.
- Tang, Arthur, Frank Biocca & Lim Lim 2004** Comparing differences in presence during social interaction in augmented reality versus virtual reality environments: an exploratory study. In Mariano Alcaniz Raya & Beatriz Rey Solaz (eds.) Proceedings of PRESENCE 2004, 7th Annual International Workshop on Presence, NSF, Valencia, Spain, 204-208.
- THE ECONOMIST 2007** Reality, only better. December 8.
- Toews Phoenix 2009** Palimpsest: An augmented reality/real world browser.
http://danm.ucsc.edu/~phoenix/data/proposal_version_1.0.pdf
- Weiser, Mark 1991** The computer for the 21st century. Scientific American, 265(3), 94-104.
- Wertheimer Max 1923** Untersuchungen zur Lehre von der Gestalt. Psychologische Forschung 4, 301-350.
- Wrobel Thomas 2009** commenting "Augmented Reality and the Future of Social Interactions" Nov 23,
<http://gamesalfresco.com/2009/11/23/augmented-reality-and-the-future-of-social-interaction/>
- Wyatt, H. G. 1928** The Gestalt enigma. Psychological Review Vol 35 (4), July, 298-310.

P.S. Weblinks have all been verified on Febr. 8, 2010