EMBODIED TECHNOLOGY AND THE PARADIGM OF UBIQUITOUS COMPUTING

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Abstract

Since the human race began, human invents technology: technology invents humans. The characteristics that make us human will continue to be manifest in our relationship with technology. Shifting boundaries between computers and everyday world. The more we depend on technologies to carry out or mediate our everyday activities, the more we will need to trust than to do so. New technologies like, Ubiquitous Computing inspire new interface paradigms, while new interfaces utilizing these emerging technologies encourage their continued refinement by revealing aspects most useful in their application. Computer technology gives a new way to understand the world by virtue of having bodies. We can think of the body as a uniquely sensitive and manifold interface. The role of computer in the world has evolved from specialized computing machines to information devices that pervade our daily lives. In my essay, I shall try to explore the challenges of Invisible Computing and simplify them, to make them visible for the research in Ubiquitous Computing. First, I will discuss what ubiquitous computing is and what it is not. Then, I will attempt to refine some paramount issues of invisible computing: What are the impacts of this kind of computing in our society? What are the embedded computers and how are they of consequence to human beings? and how can these interactions be made understandable and usable for a wide spectrum of users, ranging from information specialists to novice users? What makes a good user experience? To deal with these questions, I shall apply the philosophy of body and technology approaches of Don Ihde and Robert Rosenberger.

Keywords: Computer, Phenomenology, technology, Merleau-Ponty, Heidegger, Rosenberger, Invisible Computing, Ubiquitous Computing, User, Human-Computer Interaction, World, Architecture

1. INTRODUCTION

We know that computers are complex beasts in their own right, but for all of their internal complexity computers are just as complicated in their embedding in the outside world, even

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though the complexity of this embedding is largely invisible to the people who design computers, and to people who make a living promoting their use. And it is possible that computers might have the power to change us even when we engage with them unconsciously, as when we relate to a tool through the performance of a skill like driving or typing. In this essay, I shall try to explore the challenges of invisible computing and simplify them, to make them visible for research on Ubiquitous Computing. First of all, I will discuss what ubiquitous computing is and what it is not. Then, I will attempt to refine some paramount issues of invisible computing: What are the impacts of this kind of computing in our society? What are the embedded computers and how are they of consequence to human beings?

Making computers ubiquitous (Borriello, 2000) is not enough; we should also strive to make them invisible. But, in doing so, we will face many research challenges. Computers are everywhere. Information is everywhere, nowhere, immaterial, abstract and ubiquitous. New technologies lead to a new kind of human being-one embodied in a new technologically enhanced body. Homo is indeed *homo faber*, and he becomes more so every day. This is the new technologically enhanced human being-who is not an objective artifact (a technology) but a subjective artifact of the new technologically enhanced (perceptually, cognitively, and desire- and institutionally-oriented) human subject. The social/cultural changes that this brings about are usually neither determinate nor generally foreseeable; and, because of this, the changes will demand special oversight. This new technologically-enhanced human being opens up the social imagination of users to new worlds in which there is a redistribution of powers, such as powers to intrude into and manipulate the lives of others with or without their knowledge; powers to snoop, deceive, acquire resources secretly, defeat traditional rights and privileges as well as power to depose existing institutional authorities. The changes in the making of this new human being are unforeseeable and will eventually demand changes in ethics, laws, social structures, accountability, and institutions (Irrgang, 2007 and Irrgang 2008).

Computer technology gives a new way to understand the world by virtue of having bodies. We can think of the body as a uniquely sensitive and manifold interface. The role of computer in the world has evolved from specialised computing machines to information devices that pervade our daily lives. As research in Artificial Intelligence attempts to make computers more human, some approaches to human-computer interaction are becoming analogous to human-human interaction. By attempting to emulate human conversation, natural language technologies are poised to replace traditional graphical interfaces as a more natural means of interaction. This approach, however, overlooks the embodied nature of communication, leading to serious difficulties in usability and implementation.

It is important to explore, how integrating the multiplicity of input channels leads benefits in interactive efficiency and robustness and will also show that in trying to understand the user, multimodal systems should take into account both the user's thoughts and emotions, the motivation of affective computing. In this way, computers can hope to share some of the phenomenological experience of humans, bringing us closer together into a more intimate form of interaction. The phenomenology of Heidegger and Merleau-Ponty provides a background for the design of ready-to-hand participants and tools. In our attempts to integrate computers into our daily lives in the world, we take into account the embodied nature of our
interactions with each other and objects we manipulate. Dreyfus divides our embodiment into three modes as described by Merleau-Ponty: innate structures, basic general skills, and cultural skills (Dreyfus, 1998). Innate structures describe the way our body is built, and basic general skills are skills we learn through our bodies. Cultural skills describe our learned interactions not directly tied to the way our bodies are built. In order to understand users and interact with them as ready-to-hand participants and tools, computers should view them as embodied agents in the world with communicative and cultural skills specific to their embodiment. Natural language technologies capture a part of those communicative skills, but fail to take into account the embodied aspects of communication.

In Being and Time (Sein und Zeit) (1996/1927), Heidegger’s primary concern was the question of being which he specifically framed as the question of being-in-the-world, an inquiry that presupposes an understanding of worldliness. Worldliness, Heidegger states, is the background against which one lives. It can be the “public” world or one’s “own” world (61/65). With this understanding, Heidegger emphasizes the importance of practices in the understanding of being, practices which necessarily relate to things in the world. However, he identifies two ways in which this relationship is manifested: Vorhandenheit which reflects the detached objective perspective of the sciences and Zuhandenheit which refers to the “handiness” of practical knowledge which always already remains in the background of our understanding of the world. He uses this dichotomy to criticize the Cartesian view of the world strictly divided between the res extensa of things and the res cogitans of thoughts a division which foster the subject/object separation. He argues that Vorhandenheit, which spells out the relationship where the subject “hands” the object before (Vor) itself, forgets the background presupposed by the Zuhandenheit where subject and object are merged as one. This privileging of the subject, he concludes, leads to a dangerously incomplete understanding of being. The criticism of the subject/object relationship is a dominant theme in Heidegger’s philosophy, one which he denounces because it is limited to representation (Vor-stellung). Throughout his work, Heidegger highlights the prevalence of this relationship in our understanding of the world.

Phenomenological views on language and communication emphasise actions associated with our speech, which are ignored by pure natural language systems. Dourish describes Wittgenstein’s view of language as socially shared practices” consisting of language and the actions into which it is woven” (Dourish 2001). These actions into which language is woven are inseparable from communicative meaning. Thus, language has an extra dimension associated with social conventions and actions, such as gestures, pointing and body language. Winograd and Flores describe language whereby “words correspond to our intuition about ‘reality’ because our purposes in using them are closely aligned with our physical existence in a world and our actions within” (Winograd, T. & Flores, F. 1986). Thus, natural language systems’ attempt to strip spoken language from its phenomenological correlates and actions is somewhat misguided, yielding an incomplete means of human-computer interaction. “We inhabit conversations as embodied phenomena in the everyday world.”
As human beings in the world, we utilise our entire bodies for the purpose of communication, not simply our voices or writing, thus motivating a multimodal approach to human-computer interfaces. The tone of our voice, our body language, our gaze all constitute communicative meaning, either consciously or subconsciously. Our inclination to communicate with all our bodily facilities, either for efficiency or greater expressiveness, is captured by Bunt’s “Multimax Principle,” which states that people do not leave modalities unused that are available and useful in a given communication situation (Bunt, H. & Beun, R. 1998).

Computers that monitor and measure the affect of students in the classroom can give helpful feedback to teachers. Recognizing other peoples’ emotions and feeling or being affected by them are two different things, however. How affective computer may induce the emotional context of a certain environment is an important problem to solve. “The emotions of the game change how a player sees the field, and those aren’t things that one can get a feel from the film” (Dreyfus 2001). By embodiment, Dourish (200) means not simply physical presence, although that is certainly one relevant facet. More generally, by embodiment I mean a presence and participation in the world, real-time and real-place, here and now. Therefore Embodiment denotes a participative status, the presence and occurrence of a phenomenon in the world. So, physical objects are certainly embodied, but so are conversations and actions. They are things that unfold in the world, and whose fundamental nature depends on their properties as features of the world rather than as abstractions. So, for that reason, conversations are embodied phenomenon because their structure and orderliness derives from the way in which they are enacted by participants in real-time and under the immediate constraints of environment in which they unfold.

2. HUMAN-TECHNOLOGY INTERACTION IN A HUMAN-CENTERED ARCHITECTURE

Human-Computer Interaction (HCI) (Winograd, 2001) is concerned with the design, implementation and evaluation of interactive computer-based systems, as well as with the multi-disciplinary study of various issues affecting this interaction. The aim of HCI is to ensure the safety, utility, effectiveness, efficiency, accessibility and usability of such systems. In recent years, HCI has attracted considerable attention in the academic and research communities, as well as in the Information Society Technologies industry. The on-going paradigm shift towards a knowledge-intensive Information Society has brought about radical changes in the way people work and interact with each other and with information. Computer-mediated human activities undergo fundamental changes and new ones appear continuously, as new, intelligent, distributed, and highly interactive technological environments emerge, making available concurrent access to heterogeneous information sources and interpersonal communication. The progressive fusion of existing and emerging technologies is transforming the computer from a specialist's device into an information appliance. This dynamic evolution is characterized by several dimensions of diversity that are intrinsic to the Information Society. These become evident when considering the broad range of user characteristics, the changing nature of human activities, the variety of contexts of use, the increasing availability and diversification of information, knowledge sources and services, the proliferation of diverse technological platforms, etc.
Specifically, Human Computer Interaction (HCI) is an investigation into and a capitalization on the multistable kinds of relations that arise between the threefold of human user, artefact, and world, and how dealing with this kind of technology and these relations in many ways must be regarded as different from mainstream HCI. This subject matter is theoretically, methodologically, and empirically approached from two to HCI unconventional outlooks: a phenomenological and a design-oriented attitude to research. The main idea pursued in this work is that while HCI for historical reasons follows a tradition of disembodiment, its opposite-embodiment-needs to come into view as an alternative design ideal when dealing with mobile interaction. The tradition of disembodiment in HCI, how it is applied within mobile interaction, and the conceptual switch in focusing on embodiment and human, technology, world relations are thoroughly analyzed and discussed. A proper understanding of these issues are seen as necessary for the primary purpose of this book: to provide designers of mobile interaction with the conceptual means needed to construct new and better styles of mobile interactions.

HCI plays a critical role in the context of the emerging Information Society, as citizens experience technology through their contact with the user interfaces of interactive products, applications and services. Therefore, it is important to ensure that user interfaces provide access and quality in use to all potential users, in all possible contexts of use, and through a variety of technological platforms. The field of HCI is now experiencing new challenges. New perspectives, trends and insights enrich the design, implementation and evaluation of interactive software, necessitating new multidisciplinary and collaborative efforts. The issue of interaction in a human-centered architecture in the context of Ubiquitous Computing is to look out the pragmatic reply to; How do we interact effectively with information on a multiplicity of devices in a variety of places? Even more importantly, how can these interactions be made understandable and usable for a wide spectrum of users, ranging from information specialists to novice users? We should find a way to establish an effective interaction with information on a multiplicity of devices in a variety of places.

Human-computer interaction or HCI is the study of interaction between people (users) and computers. It is often regarded as the intersection of computer science, behavioral sciences, design and several other fields of study. Interaction between users and computers occurs at the user interface (or simply interface), which includes both software and hardware, for example, general-purpose computer peripherals and large-scale mechanical systems, such as aircraft and power plants. The following definition is given by the Association for Computing Machinery:

“Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them.”
Because human-computer interaction studies a human and a machine in conjunction, it draws from supporting knowledge on both the machine and the human side. On the machine side, techniques in computer graphics, operating systems, programming languages, and development environments are relevant. On the human side, communication theory, graphic and industrial design disciplines, linguistics, social sciences, cognitive psychology, and human performance are relevant. Engineering and design methods are also relevant. Due to the multidisciplinary nature of HCI, people with different backgrounds contribute to its success. However, due to the different value systems of its diverse members, the collaboration can be challenging. Human Computer Interaction is also sometimes referred to as the combination of man-machine interaction (MMI) or computer-human interaction (CHI).

Human experiences of our lifeworld are shaped by physical and symbolic tools and mediating tools. A common denominator in the design of many "innovative" learning environments is the insightful and careful application of computer based measurement technology as a mediating tool. Tools are a means of controlling and steering the interconnections between things and a device for coordinating shared human activities. One quote from the 1938 Logic by John Dewey, which clearly says retooling requires retooling the culture: Tool and utensil, every improvement in technique, makes some difference in what is used and enjoyed and in the inquiries that arise with reference to use and enjoyment, with respect to both significance and meaning. Changes in the regulative scheme of relations within a group, family, clan or nation, react even more intensively into some older system of uses and enjoyments. (John Dewey: LW.12.70).

Philosophy of technology deals with such questions as what role does technology (artefacts) play in everyday human experience:

- How do technological artefacts affect the existence of humans and their relations with the world and within our world?
- How do artefacts produce and transform human knowledge and how is human knowledge included in artefacts?

The philosopher of technology Don Ihde (Technology and Lifeworld, IUP, 1990) has developed in his postphenomenology the following schematic distinctions regarding the intentional relationship between humans and their world:

Embodiment relations:

(\textbf{Human} \leftrightarrow \textbf{Technology}) \leftrightarrow \textbf{World}

Hermeneutic relations (hermeneutic orientation to the world):

\textbf{Human} \leftrightarrow (\textbf{Technology} \leftrightarrow \textbf{World})

Alterity relations:

\textbf{Human} \leftrightarrow \textbf{Technology} \leftrightarrow \textbf{World}
Persuasive interfaces in a class of interfaces belonging to a trend in contemporary HCI where user experiences matter more than for instance user performance. Daniel Fallman argues that in this shift there is also a shift in accountability, but that this shift tends to remain implicit in HCI. What makes a good user experience? To deal with these issues, it is argued that HCI needs to develop a philosophy of technology. Don Ihde develops a phenomenology of relations between human users, artefacts, and the world and technologies are seen as inherently non-neutral. Albert Borgmann argues that we need to be cautious and rethink both the relationship as well as the often assumed correspondence between what we consider as useful and what we think of as good in terms of technology.

Fallman (2003a) deals analytically and through design with the issue of Human Computer Interaction (HCI) with mobile devices; mobile interaction. Specifically, it is an investigation into and a capitalization on the multistable kinds of relations that arise between the threefold of human user, artefact, and world, and how dealing with this kind of technology and these relations in many ways must be regarded as different from mainstream HCI. Whereas Lucy Suchman argues that designing technology also maximises the agency of those who use the technology, so that it can be efficient, effective and even pleasurable. “If we are to have good technology in human terms, then insights, methods and approaches from a range of disciplines need to be utilised to design and build that technology,” Suchman says. The book ‘Human-Machine Reconfigurations: Plans and Situated Actions’, 2nd Edition (Cambridge University Press, 2006) is the updated and extended version of Lucy Suchman 1987 dissertation “Plans and Situated Actions”, a frequently cited classic in HCI literature. Suchman criticizes the (back at the time) predominant cognitivist planning view on human-machine interaction, describing the connection between an action in the world and its mental representation (e.g., as a plan) as rather weak. Consequently, the tracking of an action does not automatically reveal a distinct intent. In her case study, Suchman examines the intelligent expert system of a complex copying machine that is supposed to give interactive and situational instruction to the user, comparable to a human coach. Comparing human interaction with human-machine interaction, Suchman describes the encounter of users with the artificially intelligent expert system. She sees the very limited access of the machine to the world and therefore the asymmetric ability of human and machine to make sense of the interaction as the important problem in human-computer interaction. The user’s actions as well as the machine’s reaction can be ambiguous. While in human interaction, there are several mechanisms to regain mutual intelligibility, the machine does not track some of the important events to catch the user’s intent.

User experience is now becoming central to our understanding of the usability of technology. Today many interactive technology companies describe on their Web sites their commitment to experience based design. There is also a trend in HCI communities to foreground experience entered approaches to technology, a movement reflected in several recent articles offering theoretical statements about the sensual and emotional conditions of interaction with technology (Wright, Blythe & McCarthy, 2006).

John Carroll, founder of the User Interface Institute at IBM’s Watson Research lab and a professor at Pennsylvania State University, says the ability to pick up a new device and start using it without having to read a manual is a result of the hard work of human factors researchers. Technology interfaces have improved significantly over the years, Carroll says, who notes that the Web is well crafted in many ways for designing easy software. However, he says there are still several areas where designers miss. Too often, creating an “intuitive” interface means recreating something the user is accustomed too, but humans are constantly evolving and changing. “I think people think of help systems and user interface agents by constructing a theory of mind, and the problem is that if the theory of mind is very simple and boring then it might actually be useful–predictable, understandable,” Carroll says. “But if you try to get beyond that, and especially if you lie--and by lying I mean cases where designers have gone to some effort to project intelligence that their software does not have in any serious sense--it may have it in an idealistic sense but it doesn't do anything intelligent, creative, human--you get a breakdown.” (Carroll & Moran, 1996 and Carroll, 1998).

In a recent study Peter Wright and John McCarthy presented a basis for thinking about an evaluating technology as experience. Wright and McCarthy show how technology can be seen in terms of experience with technological artifacts. This approach orients us toward the felt-life of technology-toward engagement, enchantment, irritation, and fulfillment. But we also recognize that the feeling-life does not begin and end with the immediate quality of an experience, rather it extends across space and time to the sense we make of experience in terms of our selves, our culture, and our lives. [Cf. Wright, P.C., McCarthy, J.C., & Meekison, L. (2003). Making sense of experience. In M. Blythe, A. Monk, C. Overbeeke & P.C. Wright (Eds.), Funology: From usability to user enjoyment (pp. 43-53). Dordrecht: Kluwer].

In “Technology as Experience” (Cf. Technology as Experience, John McCarthy and Peter Wright, MIT, 2004) John McCarthy and Peter Wright argue that any account of what is often called the user experience must take into consideration the emotional, intellectual, and sensual aspects of our interactions with technology. We don’t just use technology, they point out; we live with it. They offer a new approach to understanding human-computer interaction through examining the felt experience of technology. McCarthy and Wright illustrate their theoretical framework with real-world examples that range from online shopping to ambulance dispatch. Their approach to understanding human computer interaction “seeing it as creative, open, and relational, part of felt experiences” is a measure of the fullness of technology’s potential to be more than merely functional.
Lucy Suchman offers a critical review of how social and material relations are figured at the human-machine interface. Focussing on recent initiatives in the design of software agents, mobile and wearable devices, and ‘ubiquitous’ or pervasive computing, Suchman suggests that these new technologies rest on some very old assumptions regarding identity, difference and interactivity. Software agents and 'smart' devices are the current expressions of a longstanding dream of others that know us, accompany us, and ensure that we are always “at home.” Agent technologies promise the services of a proxy who travels while we stay in place, while pervasive computing, particularly in the form of ‘intelligent environments,’ promises to provide us with greater mobility without a loss of familiar ground. Relevant to both of these projects is the question of how we imagine humans, artifacts and the relations between them. As an alternative, Suchman is providing a sketch to some new resources for imagining connection less in terms of the joining of entities that are otherwise separate (human or machine), than as the dynamic intra-action of specifically embodied and embedded sociomaterial relations.

So the issue of interaction in a human-centered architecture is to look out the pragmatic reply to: How do we interact effectively with information on a multiplicity of devices in a variety of places? Even more importantly, how can these interactions be made understandable and usable for a wide spectrum of users, ranging from information specialists to novice users? We should find a way to establish an effective interaction with information on a multiplicity of devices in a variety of places.

3. RELATION BETWEEN HUMAN COMPUTER INTERACTION AND UBQUITOUS COMPUTING
According to Don Ihde (1990) and Robert Rosenberger (2009a, 2009b) everyday users of computers come to embody their devices in significant ways. According to Robert Rosenberger, these embodiment relations often become deeply transparent and deeply sedimented. Rosenberger comments, when a person uses the computer to perform everyday tasks such as typing, reading emails, or surfing the Internet (of course which tasks qualify as “everyday” depends on the individual), she or he may grow barely aware of bodily interactions with the device. “The bodily, conceptual, and perceptual habits this person has developed enable conscious attention to be directed to the tasks being performed with the computer, rather than on the technological mediation that makes those tasks possible” (Rosenberger, 2009a).

According to Rosenberger (2009a, 2009b) model of phenomenology of human-computer interaction, the high degree of sedimentation of the typical relation to a computer is exemplified by the experience of the keyboard. To illustrate this point, Rosenberger argues when as a user types, she or he has a deep bodily understanding of the placement of the keys. “The transparency of this relation is so high that the user’s conscious thoughts are occupied with the content of what is being written, rather than how typing is done. The user thinks in whole words and ideas as her or his fingers tap out the spellings of those words on the keyboard. However, imagine turning the keyboard upside down; this user would not be able to apply the same bodily habits to this new context of interface. When the keyboard is oriented in the normal way, it can be engaged with considerable skill. Oriented differently,
these habits of relation become less relevant, if not an obstacle. The user must actively search for each key-thinking about what is written in terms of letters rather than simply meanings and whole words. The transparency and sedimentation of the relation must be slowly regained in terms of the upside down keyboard orientation” (Rosenberger, 2009b).

The everyday user also shares a hermeneutic relation to many aspects of the computer. Onscreen icons, buttons, and cursors appear as symbols that convey information. Icons that open programs, or open and close windows, appear as emblems and pictures. The cursor itself as it is used, controlled by the mouse and keys, changes into different shapes, such as arrows, pointing fingers, swirls, and hour glasses. The user must be familiar with the meanings of these different symbols - the language of onscreen interface. If accustomed to interpreting these symbols, a high level of transparency develops and interacting with these encoded icons, buttons, and ever-morphing cursors comes as second nature. Their meanings are conveyed in perceptual gestalts. Refined habits of perception and interpretation enable the user to attend more to what she or he is doing than to interpreting symbols (Rosenberger 2009a).

Ubiquitous computing, in the words of the late Mark Weiser (1991 and 1995) “the third wave in computing” is just now beginning. First, with shared mainframe computers, and now in the personal computing era with persons and machines starting uneasily at each other across the desktop. Next comes the era of ubiquitous computing or the age of calm technology (Weiser 1995 and 1996) (better said, it has already arrived) - calm technology meant to be working in the background of human beings and supporting their lives, is also called as Invisible Computing or Invisible Computer at work. Alan C. Kay describes this as Third Paradigm computing. The first wave of computing, from 1940 to about 1980, was dominated by many people serving one computer. The second wave still peaking has one person and one computer in an uneasy symbiosis, staring at each other across the desktop without really inhabiting each other's worlds. And, the third wave, just beginning, has many computers serving each person everywhere in the world. This is called as invisible computing (Cf. the research of Professor Don Norman). Norman argues in his book The Invisible Computer that the PC was aimed at the “early adopters” (this terminology is popularized by Geoffrey Moore). The first step is to design information appliances for the mass market. Norman advocates a “user-centered, human-centered, humane technology of appliances where the technology of the computer disappears behind the scenes into task-specific devices that maintain all the power without the difficulties.” [See “Preface” in Norman, 1998]. So, the vision of Don Norman seems to me justified, by visualizing the visible problems of the Invisible Computer.

Some Main Points Related to UC

Not just laptops
24-hour access to Computer and Internet Infrastructure
Mobility: “any place/any time”
Personal Student/Computer relationship
Comprehensive e-services
Access to quality support
How can physical work, play, and living spaces be enhanced through digital information systems? How can the long biological experience of humans in manipulating physical objects be exploited as an interface to information systems? Researchers propose that contemporary models that focus on the computer as a separate appliance will seem like an anachronism in the digitally enhanced future. Sensing, computing, and communication functions will become invisible and integrated into the manufacture of many objects and the architectural arrangements of spaces.

UC can also be defined as an art of technology transparency or tangible computing. In the words of Bill Buxton (1998): “Rather than turning inward to an artificial world, ubiquitous media encourages us to look outward. It expands our perception and interaction in the physical world...”
What Ubiquitous Computing Isn’t

Ubiquitous Computing is roughly the opposite of virtual reality (VR), where virtual reality puts people inside a computer-generated three dimensional world. Ubiquitous computing forces the computer to live out here in the world, make connections with people. VR is primarily a horsepower problem: whereas ubiquitous computing is a difficult integration of human factors, components of computer science, engineering, and social sciences.

Early Work in UC

The initial incarnation of ubiquitous computing was in the form of tabs, pads, and boards, built at Xerox PARC, 1988-1994. Recently, ubiquitous computing has kicked off the recent boom in the areas of mobile computing research, although it is not the same thing as mobile computing, neither a superset nor a subset. UC has roots in many aspects of computing. The current mode of computing was articulated by Mark Weiser in 1988 at the Computer Science Lab at Xerox PARC.

Mark Weiser Described the UC in Two Forms

(a) The social scientists, philosophers, and anthropologists at PARC have envisioned the computing and networking. Activate the world.

(b) For the past nearly 30 years interface design and computer design has gone through some dramatic developments. The highest ideal of the development is to make computer so interesting and so wonderful that we have never want to be without it.

In the $b$. form, Mark Weiser had seen a “less-traveled” path he called the invisible, and he called the computers embedded in the background of humans as Ubiquitous Computing. So, he was the first computer scientist to envision the era of UC (Weiser, 1996).

Gradually, the people at PARC focused on Ubiquitous Computing research. Weiser also realized that they were working on technologies that evoke the suspicion of people, and he therefore defined the following Principles of Inventing Socially Dangerous Technology:

1. Build it as safe as you can, and build into it all the safeguards to personal values that you can imagine. Tell the world at large that you are doing something dangerous.

4. TELECOOPERATION RESEARCH

Telecooperation is the new wave of technology-an application of information and communication technologies used by individuals and organizations to enhance communications and access to the ubiquitous information. Perceiving the several components of Telecooperation, it needs new computing skills because there is a shortage of computing talent in systemic thinking, problem-solving, communicating, and teaming, as well as in assessing schedule, cost, risk, and potential impediments. Telecooperation enhances the works in the organizations, universities and corporate firms. It uses the skills and techniques of Third Wave computing, known as Ubiquitous Computing (UC)-the other form of UC could be known as The Invisible Computing, which includes several challenges.
Individuals who learn and apply the skills of telecooperation gain new leverage, both by having a wider network of “useful connections” and by having better access to timely information. Organizations that successfully apply telecooperation methodologies can enhance customer requirements and supplier communications, dramatically reduce costs, and increase the standing in the community and their influence with policy makers. On the other hand communication in hard copy has been an essential ingredient to human progress. It empowers people to decide if they want to expand their horizons, capture new opportunities, and exercise greater degrees of freedom and choice. Today, the Internet offers promises of distance education and learning at speeds unheard of in the hard copy world.

Telecooperation is an outstanding example for the power of enabling technologies. It stands for the fusion of computer science, telecommunication and multimedia to carry out a cooperative process among organizations and individuals by having better access to timely information over a distance between two or more locations. This can be achieved by means of information, communication and new-media technologies. It comprises procedural and collaborative modes of task and its focus lies on the cooperation in the broader sense. It is concerned with a series of issues ranging from particular application domains such as the global office, innovative services, telework, telemedicine, telelearning and education, to the tools for communication and cooperation. During recent times, Electronic Commerce becomes the main beneficiary of telecooperation methodologies with an exponential progress prompted by the fast spreading of the Web.

Telecooperation [1] and collaborative work are key openers to changes in different areas such as tasks, structures, cooperation and coordination processes, the workplaces, and the level of employment of an organization. As part of the global knowledge society, public administration is on its way to a virtual organization, networked via telecooperation. Research in this field is often restricted to laboratory studies or to studies in which either the observation period is short or the observation intensity is low. The use of telecooperation is a promising means to meet the rising demands of complexity of work processes for public administration. New forms of Computer Supported Cooperative Work (CSCW) have lead to better efficiency due to time, communication, coordination, and costs. New forms of work (more teamwork, higher autonomy, flatter hierarchies, and pro-active initiatives) will emerge and limitations of collaboration by distance and time will fade. Actually researchers are facing the requirements and changes which occur on the way towards these challenging goals. As is often the case in the early phase of development and adoption of new technologies, the window of opportunity is open to shape technology integrating organizational and users’ needs.

As the amount of information and communication increases dramatically, new working environments must provide efficient mechanisms to maximize the benefits of these developments. In a study, researchers have proposed a telecollaboration environment based on agent technology, which could be used as an information infrastructure for cooperative buildings or virtual enterprises. The number of communication and information services increases rapidly in number and complexity. Therefore, researchers argue mediating
components between users and services are required. In the environment being described it is suggested to deploy a personalized agent cluster for each user and network-wide directory, broker, and trading service. The agent cluster acts as a surrogate for the user in the system. In each cluster a variable set of personalized agents is aggregated according to the requirements of the user. Exemplarily the architecture and functionality of a communication agent as one part of an agent cluster is described.

5. VISIONS OF ARTIFICIAL INTELLIGENCE AND LIFEWORLD

The paper Reflections on the Limits of Artificial Intelligence (AI) (published in Ubiquity, Volume 5, Issue 38, and December 1 - 7, 2004) is interesting and stimulating and at the same time raises concerns about Natural Intelligence. Phenomenologist philosopher Hubert Dreyfus argues that symbolic AI has failed. During 1950, Alan Turing predicted that there would be a machine that would behave intelligently enough to be indistinguishable from a human by the year 2010. Given the state of things today, it is highly unlikely that the prediction will be met, Dreyfus argues. By taking this hypothesis, I see the problem of common-sense knowledge in AI research. The argument made by Alexandru Tugui, “Artificial intelligence is based very much on symbolic logic, and has not succeeded in involving so-called affective logic” is plausible on the limitations of AI. I would like to extend the plausibility of the critics.

Artificial Intelligence (AI) in the 50s and 60s suggested that the promise was not unrealistic, as Dreyfus maintains. Newell and Simon (working at RAND) showed with concrete programs that computers could do more than calculate on numbers; they could represent with symbols and programs that operate on these symbols, and could display aspects of intelligence. This symbolic information processing model of the mind was able to produce programs that solved puzzles, played games and proved theorems in logic and mathematics. But problems began to surface, as Marvin Minsky had thought that what we needed to program in common sense was about 100,000 facts. A generation later he is of the opinion that the AI research problem is the hardest science has ever undertaken. So, the reaction of the AI community to problems of these kinds is to investigate micro-worlds, i.e., areas where the solution does not depend on common sense knowledge. The goal of artificial intelligence is the simulation of human intelligence. How do we determine whether artificial intelligence is approaching or has reached its goal? One might reply that a machine should by considered intelligent if it does things that would require intelligence if done by humans. The key for understanding human intelligence is the social competence of human beings. The future construction of intelligent robots will be inspired by our knowledge about the human brain and human social intelligence [Borgmann, 1994 (271-283)].

On the other hand Stuart Dreyfus (younger brother of Hubert Dreyfus) tells us what human intelligence is by arguing that expertise is pattern discrimination and association based on experience. It is intuitive. There is no evidence you can reduce it to rules and theory. Hence, Artificial Intelligence probably can’t be produced using rules and principles. That’s not what intelligence is, says Dreyfus. 2
We know by various literatures that the discussion of artificial form of humans is advanced both in the areas of the AI & its intellectualism and the Human-genetics within the physical-corporeal (human embodied) range. The dream of artificial beings is an old one, but only in this century have these fantasies turned into technical reality: robots. As we have entered into the 21st century, I think we have to work out the questions: what have we learned from the developments so far? What will be possible in the near future? And, how will the relationship between robots and human change? Answers to all such questions are worthless and in vain if we can’t explore what it means to understand human intelligence-which is the social competence of human beings. Is the future, the construction of intelligent robots will be inspired by our knowledge about the human brain and human social intelligence.

Technology (Stallings, 2002) today allows us to record, analyze, and evaluate the physical world to an unprecedented degree. From supernovae to subatomic phenomena, the large and the small have been observed with increasingly greater accuracy, and we can expect organizations in the new millennium to depend increasingly on precise measurements to ensure they meet their mission requirements. Our Information Age owes a great debt to the pioneers of the 18th and 19th centuries who developed the mathematical tools for scientific measurement. We also owe a debt to those who courageously defended their convictions that the objects of their study-whether light, germs, or chemicals - are subject to meaningful analysis. In the 20th century, most definitive techniques for measurement were to be found in the physical sciences, with psychology and education achieving more modest and less definitive gains in the measurement of human mental achievement and potential. As the first decade of the 21st century sees a rapidly-increasing and global need for learning which far exceeds the current delivery capacity of educational and training institutions, the measurement of human capabilities and achievement will require significant progress in the near future.

Dees Stallings (2002) presents different perspectives concerning the future of human intellectual capabilities. Devlin, Dean of the School of Science at Saint Mary’s College, California, as well as Senior Researcher at Stanford’s Center for the Study of Language and Information and the author of a number of books on human reasoning, is an enthusiastic promoter of the development of human capabilities. Ray Kurzweil, MIT visionary and author of The Age of Spiritual Machines and numerous other works on artificial intelligence, has supported the dominance of computer-based instruction over human teaching. Kurzweil develops a convincing argument that computers will surpass humans in all areas of intelligence by 2020, with “significant new knowledge, created by machines with little or no human intervention.” In education, he predicts, “Learning at a distance ... is commonplace.” He continues, “To the extent that teaching is done by human teachers, the human teachers are not in the local vicinity of the student.” Devlin’s position is that our quest for artificial intelligence has already run its course in the last century, and it is time to focus on a new goal - the development of greater human capabilities. In his words, we “have come to realize that the truly difficult problems of the information age are not technological; rather, they concern ourselves - what is it to think, to reason, and to engage in conversation.” Devlin is a proponent of the argument that our assimilation of the most significant developments of contemporary mathematicians will usher in a new “Golden Age” of human capabilities, not unlike that in which the Greeks produced Euclidean geometry and Socratic dialectic.
At this point, let me propose some classical futuristic ideas about the scenarios of the technological future (technology of the future? - this can be understood in two different ways: how technology could be in the future and how the future is anticipated through technology and how our Lifeworld is shaped). The world-wide classroom is preparing for a future where new platforms and service architectures enable the virtual highways to bring information to end users via wireless, mobile, fixed lines, fiber cable and finally to the Internet, converging seamlessly with boundless energy. The Internet gives diversified learning styles an opportunity not provided previously by other means of communications - allowing people to think critically and communicate freely, boundlessly, independent of time or place, from their home, business or vehicle. The Internet has grown in recent years from a fringe cultural phenomenon to a significant site for cultural production and transformation. The Net offers us a chance to be a true global community. It also gives us a challenge to think critically about our own lives. It has given us the responsibility to govern ourselves. The Net has some unique advantages: It takes away many logistical difficulties of space and time and allows information to flow faster and more efficiently. Here it seems that the many possibilities accomplishing the goals of learning and education via the Net are possible. These perspectives will be increasingly important to decision making about education and training for the coming decades.

The roles that humans and technology will play in education and training, especially in distance education, will shape the future of human activities more than we perhaps realize. Because the powerful influence of technology on the workplace and education will only increase, it is likely that we must revise our concepts of teaching and learning. For educational institutions this will require new mission statements, revised catalogs and other materials, different learning environments and methods of instruction, and, perhaps most significantly, new standards for measuring success.” Computers are becoming more powerful at an ever-increasing rate, but will they ever become conscious? Artificial intelligence guru Ray Kurzweil thinks so and explains how we will “download” our software (our minds) and “upgrade” our hardware (our bodies) to become immortal — before the dawn of the 22nd century. In this debate with his critics, including several Discovery Institute Fellows, Kurzweil defends his views and sets the stage for the central question: “What does it mean to be human?”

I believe-most of our understanding in the world of what it is like to be self-aware and embodied is so ubiquitous and action-oriented but hidden in our unconscious; there is every reason to doubt that it could be made explicit and entered into a database in an embodied but non-self-aware computer. We can attain explicit knowledge of the world through our understanding of the world, by virtue of having bodies that are self-aware. We can find answers to questions involving the self-aware body by using our physical body in the world. Human beings respond only to the changes that are relevant given their self-aware bodies and their interests, so it should be no surprise that no one has been able to program a computer to respond to what is relevant. Self-aware Bodies are important for making sense of the world. Forms of life are organized by and for beings physically embodied like us. Our
self-aware embodied concerns so pervade our world that we don’t notice the way our self-aware body enables us to make sense of it. So, if we leave our self-aware embodied commonsense understanding of the world aside, as using computers forces us to do, then we have to do things the computer’s way by ‘embodying ourselves in it’ using its formal structures as a means of symbolic communication in place of language. What follows then is that we replace the semantics of language with the semantically relevant structures of the computer which then has to function as part of the extended human body of the researcher.

Phenomenologist Hubert Dreyfus takes the issues of how human bodies in the world function in understanding the world and comments, “We have got bodies, and we move around in this world, and the way that world is organized is in terms of our implicit understanding of things like we move forward more easily than backward, and we have to move toward a goal, and we have to overcome obstacles.” Those aren’t facts that we understand. We understand them just by the way we are in the world, such as we understand that insults make us angry and such as we have pains, frustrations and pleasures and such as we understand the agony and joy of other human beings. You state those as facts. But, I think there is a whole underlying domain of what we are as emotional embodied beings which we can’t completely articulate as facts, a domain that underlies our ability to make sense of facts and to find any relevant facts at all. Dreyfus emphasizes that, for a human being the experience of the world as a whole precedes the experience of independently distinguishable elements. Thus a depressed person experiences the world as “grey” and “meaningless” before specific elements stand out in it, and one may experience a new environment as “safe” or “threatening” before distinguishing discrete objects; it is the situation as a whole that draws out the experience.

It is important to understand what is ‘phenomenology’ and ‘world’. Generally, the world offered to us through the natural sciences is interpreted as a material world, independent in its being of human beings. But, through phenomenology the world is manifested in and through self-aware human experiences. Phenomenological perspective takes the self-aware human experience of ourselves in our everyday encounters with the world. This human world that is not entirely objective, as it is filled with experienced structures, like smells, feelings, frustrations, fantasy, threats and goals. Nor is this world present to us in subjective consciousness, in the sense that the structures that we learn to perceive in the world-including the subject - are not our own arbitrary mental constructions, since smells and obstacles are not things that we invent but are made manifest in our experiences whether as learned entities in the way that neuroscientists and developmental psychologists speak of learning - or as acquired in some other way during our encounters with the world.

Footnotes
[1] German researchers have argued; Telekooperation bezeichnet nach Aussage der Autoren “die mediengestützte arbeitsteilige Leistungserstellung zwischen verteilten Aufgabenträgern, Organisationseinheiten und/oder Organisationen.” Another significant approach regarding the telecooperation is maintained by Telecooperation Research Group at the Darmstadt
University of Technology, where researchers have structured his group into two major areas called uBIZ and uLEARN, where uBiZ stands for ubiquitous business, information, and zest and uLEARN stands for ubiquitous Learning. See for details at http://www.tk.informatik.tu-darmstadt.de and http://www.tk.informatik.tu-darmstadt.de/de/research/

(Telecooperation means targeted cooperation among humans and machines, based on information & communication technology. Ubiquitous Computing (aka. Pervasive Computing aka. Ambient Intelligence) denotes the next era of Telecooperation, where humans are surrounded by zillions of networked computers that support all aspects of our daily life. Research@TK emphasizes cooperation of different kinds of parties: humans-most of them not using a desktop PC; smart services-distributed context-aware software components, smart items of all kinds-wearable computers, appliances, “spaces”, and, smart content-knowledge media based on multimedia documents & streams)

REFERENCES

Embodied Technology and the Paradigm of Ubiquitous Computing


