Orchestrating the dialogue; a brief overview of human-computer interaction.

By tjerk timan, 5798590

"We science-fiction writers asked you guys [designers red.] for a talking computer; you gave us Microsoft Clippy" [Bruce Sterling, IDIF conference Potsdam 2007]

Introduction

Most challenges in the near future concerning interactive media are in the combination of two realms: the physical and the digital. Where these two come together lots of things happen, especially in case of a networked situation (e.g. where digital data can be represented and manipulated on multiple artifacts). The great advantage to moving away from the screen is that we can move away from the world of metaphors (like the desktop metaphor on screen) to direct couplings of meaning and action.

Within current media discussions, one of the topics is that of 'Ubiquitous Computing' and 'Ambient Intelligence' and its rapid development and prospects. What is often discussed, however, is nearly never actually done. By this it is meant that, amongst other keynote speakers also noted on the IDIF conference, we still seem to lack the power to really integrate these prospects into daily life. Where in newly founded research institutions ideas, concepts, methodologies and framework are introduced, this has not quite saturated yet into daily-life products.

In order to understand or grasp, what is currently going on, a short review on HCI is given. Next, an overview of the recent discussions and problems is mentioned, in order to map out the current field f what I would call generally 'interaction design', to close with a short personal view/ opinion on the matter.

New Paradigm

We have to make a bridge from screen to the real world again, where the challenge is the spreading and representation of data.

So within networked human-artifact interaction, there is still a lot of room for innovation. Where ways of interacting with digital data are mainly dealing with on screen-and- button, maybe the time is ripe for a new interaction paradigm. In this short review an attempt is

made to show the current status of this new paradigm.
In taking a designers perspective on HCI history, the invention on the mouse (Engelbart) was a clear first step in making digital data accessible and easier to manipulate. In his "mother of all presentation", Engelbart showed the power and potential of physical input devices. Coming from a computer science background, he understood that, in order to make the computer accessible for 'everyone' by creating these devices, much more could be achieved with this computer. On the level of efficiency in daily work or instance, but also the computer as a social tool, overcoming language barriers.
In the development of computer input devices, not much has happened since, except from some variations on the mouse (trackball, tablet). Within other areas of technology, the introduction of the mobile phone, the digital camera and the mp3 player have their very strong influences on a techno-sociological level in the sense of treating data (sharing, copy-pasting, distributing etc.) but still the devices themselves are based on a screen-button computer paradigm. Ullmer and Ishii introduced a framework in 1997 in which this is mapped: Where in traditional HCI there is a clear boarder between in-and output (mouse and keyboard in, screen out), they state that we have to look at representations of actions: (manipulated) data needs to be re-thought. The term tangible interaction is introduced here.

Interactivity

In order to discuss this new paradigm, lets first take a look at the old one. The key element in all these discussion can be pinned down to the term' interactivity'. Also, the theorists discussed below were focused on human-computer interaction in terms of a classical HCI setup; where screen, mouse and keyboard are the tools to work with. Subsequently, the desktop metaphor was a ground- breaking one. Lots of theories involve cognitive science, human intellect and representation of action, with the key element being functionality and rationality. (This focus is changing, in the new paradigm context).
An important start is made with the developments deployed by the Augmenting Human Intellect Research Centre at Stanford University in the mid sixties. In a paper published by Engelbart and English, they state the purpose of this research center:
Developing an experimental laboratory around an interactive, multi-console computer

display system and working to learn the principles by which interactive computer aids can augment their intellectual capability. The research objective; developing principles and techniques for *designing* an 'augmentation' system. The method being strongly empirical with the setup that the research group itself is also the user group. In a highly structural manner, the aim thus was to look at current working situations: projects, processes, planning, file management etc. in a time where the computer just arrived within the working routine.

In working on-screen with multiple people, lots of problems occurred in what exactly this data on screen is, and how to handle and manipulate data. Where before-computer times worked with physical files and structures (think of a file cabinet), the computer offered lots of new possibilities: that of working together on one file, sharing files, simply adding or removing content and so on. But, it also gave a serious danger; that of mapping and representation of data. Not only how to visualize the data on screen, but also how to literally handle this computer. With the introduction of the mouse, developed at this research center, a very important step was made; a physical tool allowing for 'freedom' on the screen; by decoupling actions directly linked with keyboard input, now a freedom in the x,y plane is given, allowing for much more possibilities, like dragging and dropping, selecting, and much more.

During these techno-utopian times, it was thought that, when able to create a web of computers, it would start to play a very important role not only in a working sphere, but also on a social level, improving education, breaking language barriers and allowing people to share knowledge worldwide, via the screen. Although now considered naïve, there predictions were hopeful, and the introduction of the mouse have proven its worth, being used worldwide, still as the number one tool to interact with a computer.

Still, in shaping the dialogue (between human and computer resp.), one can question the mouse in a couple of ways: one being its representational value. Due to its non-semantics, the mouse is neither symbolic not iconic; While a letter on a keyboard translates directly in the same symbol on-screen, I can understand the link between the physical and the digital (without having to now exactly how the computer manages this translation), the translation of a mouse movement is reduced to an real movement in the x,y plane towards a movement in the x,y- plane on screen. But what about up-and down, 3d, speed of movement, gestures, force and so on? One mayor problem, for instance, is the moving front and back of the mouse on screen and the movement of the cursor up and down. Is moving forward automatically mean moving up the cursor?, or down? Where may would automatically state that this problem is on of 'software'; of interpretation of the computer to the input signal of the mouse, it is more logical (and difficult) to state that this is a problem of the mouse. The pure physical shape of the mouse does not tell me anything about its possibilities; it is probably the most *non-self-explanatory* artifact in a daily surrounding; its non-ness giving it 'freedom' of interaction on a screen, but this freedom also shows its limits in facilitating the dialogue between human and computer.

Theory overview

Before explaining more about all the challenges concerning this dialogue, also within the development of the 'world as interface' paradigm, first some alternative developments parallel to the mouse are mentioned:

In the paper '*put that there*', published in 1980 by Richard A. Bolt, an alternative system is proposed by the Architecture Machine Group at the MIT, where the main goal is to investigate voice and gesture recognition as a way to manipulate on-screen data.

A physical interface is produces in that sense that virtual and real space are mapped; In a setup, a large screen is setup in a further 'normal' room setting, which a bunch of input devices. When properly *orchestrated*, the two spaces can merge, creating a seamless transfer between the virtual and the real. The challenges here lie in space (where is the user situated, and what can we do with this information?) and in speech recognition (what is said where, and how does this effect the virtual). Without discussing the whole experiment, concluding words of the paper are:

"The power of the described technique (voice recognition and mapping of the user in the room) it that indications of what is to be done with this visible out-there-on-view items can be expressed spontaneously and naturally in ways which are compatible with the spirit and nature of the display: one is pointing to them, addressing them in a spoken words rather than typed symbols." Considering this was published in 1980, some very important aspects are mentioned here that implicitly still dominate current discussions concerning the dialogue of HCI and interaction design.

The first one being the moving away from the screen to the room (a first step towards 'the world'). In trying to introduce an alternative, probably by technical constraints, the experiment showed an interesting step in 'what-if' the interface were to move to the whole room. As showed in the experiment, which was focused on one person only, questions rise of who is in control and when? Moreover, while voice-and gesture recognition technologies are still very difficult to manage even today for one user, it becomes incomprehensible when multiple users are to interact with the system. But, unlike the research done by Engelbart discussed earlier, the shear possibility of multiple- and social interaction with a computer system is considered for the first time.

Also, the terms spontaneous and natural occur clearly in discussing how to interact with a computer. This shows two things: The first being the fact that dealing with a computer now moves away from functionality to what we would now call 'experience', secondly that already in 1980, the computer is expected to move away into the background, and the focus shifts from the question how a human should deal with computer data, to the question how the computer system should interpret a human.

In his paper 'Responsive Environments', Krueger statements point a similar direction, in a sense that he emphasis the goal of human-computer interaction and the implications of it, when it will be literally everywhere, ubiquitous. "We are incredibly attuned to the idea that the sole purpose of our technology is to solve problems. It also creates concepts and philosophy. We must fully explore these aspects of our inventions, because the next generation of technology will speak to us, understand us, and perceive our behavior. It will enter every home and office and intercede between us and much of the information and experience we receive. The design of such intimate technology is an *aesthetic* issue as much as engineering one. We must recognize this if we are to understand and choose what we become as a result of what we have made."

In expressing his disappointment with the current dialogue, that of a seated man sitting behind a machine, poking with his fingers or perhaps waving a wand over a tablet, Krueger turns to interactive art as a platform to explore interactive environments and its possibilities to alter this dialogue. In this 'responsive' environment, computers monitor and perceive the actions of the 'user' and responds via audio and video in a complex way, where the aim is to play with the user's expectation of the system, trying to create a new context and a new dialogue. In reflection on this installation in an art environment, Krueger states the following: response is the medium (Which is actually a preliminary of the current 'aesthetics in interaction' or 'designing interactions', where the interaction itself is the object of study). In all the test setups, the contribution to the dialogue was responsiveness. Not in a planned-mapped-take-this-path-way, but in a way that surprised both participant and experimenter (thus, also the system?). Krueger interprets these interactive environments as the following:

- an entity which engages the participant in a dialogue.
- a personal amplifier, to evoke and facilitate social interaction
- a kind of eco-system of other (smaller) environments/ interactions
- an amplifier of movement
- an instrument (in this sense, that it is more than a functional in- output device
- a means of turning one's body into an instrument, allowing it to play and interact.

Where this all comes down to, is presenting another view to computer-human interaction, where the 'poetic composition of experience' is said to be most promising.

While these responsive environments were situated within the field of art, a parallel can be drawn with early scientific work of Brenda Laurel on how to look at and orchestrate this interaction, this dialogue. In her publication of 1991, called ' the six elements', Laurel creates draws a parallel between human-computer interaction and that of classical theatre described by Aristotle. One of Aristotle's fundamental ideas about drama (as well as other forms of literature) is that a finished play is an organic whole. He used the term organic to evoke an analogy with living things. Moreover, he introduced a model by which a disciplined way of thinking about designs of a play; in this case the play being between a computer and a human.

The model consists of six elements by which the whole process can be described, being action, character, thought, language, pattern and enactment. The figure below shows the comparison Laurel makes between drama and HCI. Aristotle maintained that the object of (i.e., what is being imitated by) a drama is action, not persons: In a purely Aristotelian sense, an agent is one who takes action. Interestingly, Aristotle admits of the possibility of a play without characters, but a play without action cannot exist (Poetics, 1450a, 22–25) At the grossest level, people simply attribute agency to the computer itself ("I did this, and then the computer did that").

Element	In Drama	In Human-Computer Activity
Action	The whole action being represented. The action is theoretically the same in every performance.	The whole action, as it is collaboratively shaped by system and user. The action may vary in each interactive session.
Character	Bundles of predispositions and traits, inferred from agents' patterns of choice.	The same as in drama, but including agents of both human and computer origin.
Thought	Inferred internal processes leading to choice: cognition, emotion, and reason.	The same as in drama, but including processes of both human and computer origin.
Language	The selection and arrangement of words; the use of language.	The selection and arrangement of signs, including verbal, visual, auditory, and other nonverbal phenomena when used semiotically.
Melody (Pattern)	Everything that is heard, but especially the melody of speech.	The pleasurable perception of pattern in sensory phenomena.
Spectacle (Enactment)	Everything that is seen.	The sensory dimensions of the action being represented: visual, auditory, kinesthetic and tactile, and potentially all others.

Comparison schedule of drama and HCI

Laurel states that If we aim to design human-computer activities that are— dare we say— beautiful, this criterion must be used in deciding, for instance, what a person should be required to do, or what a computer- based agent should be represented as doing, in the course of the action and that the form of an interactive drama must enable the user to participate in the fantasy world as an active character, becoming a dramatic agent him- or herself within the 'play'.

The mayor contribution of the statements made by Laurel is the fact that we must move the focus towards the action – and interaction itself if we want to improve the dialogue between human and computer, where this interaction becomes a research goal itself. However useful, Laurel does not directly give clues on how to actually implement this theory.

In a publication 'Direct manipulation' by Ben Schneiderman in 1983, a view is given on some of the issues concerning the implementation of what Schneiderman calls interactive systems, as well as some statements concerning user involvement. During the time of publication, a shift was taking place in interacting with a computer, by the introduction of more graphical user interfaces (GUI's) rather than pure code. Via this new way of manipulating data, Schneiderman introduces the term direct manipulation. In a comparison between driving a car, which he states a something that has become a common skill in our culture, and the seemingly expert-task of handling a computer, this new, more visual way of interacting is promising,, due to its direct representation of relations on the screen.
So, quite in contrast to what is thought today about HCI, here it is claimed that graphical representation is giving us more sense of control and understanding of what a computer does and, more importantly, what we as users can do with it. As Schneiderman puts it: 'Direct manipulation can be applied to replace traditional question-and –answer computer-assisted instruction with more attractive alternatives'. However, this new shift does not immediately means a better performance: a couple of problems are stated that are quite relevant for the dialogue discussion:

- the wrong information can lead to greater confusion
- users must learn the meaning of graphical representation, which is often more difficult (or at least ambiguous) than a textual representation.
- This leads to a greater chance of misinterpretation of graphic representations. Think of cultural, and social differences in ascribing meaning to visual signs or icons, for instance.
- a fourth, practical problem Schneiderman foresees is the amount of space graphical representation take up (over textual) on a screen.

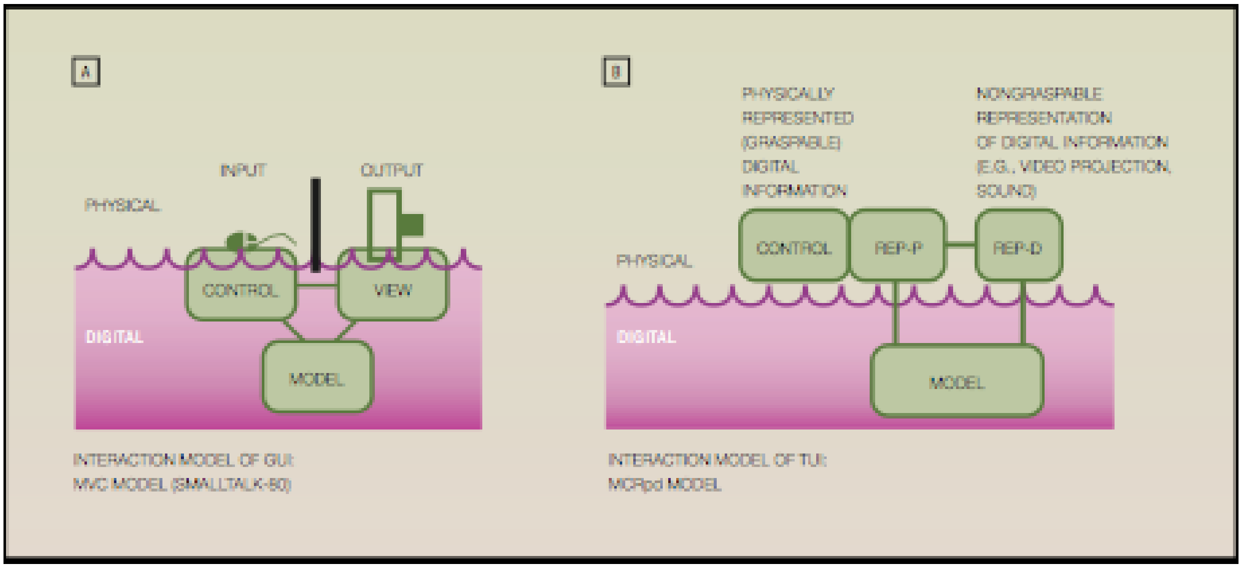
Another large discussion point is mentioned; one that seems insolvable within HCI; that of metaphors. Where 'simple metaphors, analogies or models with a minimal set of concepts seems appropriate' according to Schneiderman, still, users do not automatically share the same idea of a metaphor as the designer. As discussed later, within current development of HCI, it is stated that we have to move away form the use of metaphors altogether, where manipulation is maybe not only via a screen, but even more direct, altering the principles of

direct manipulation introduced here altogether.
An important notice is the introduction of the syntactic/semantic model in (re) viewing the dialogue. Where first, skills have to be learned on a syntactic level, understanding the action and representations, the next phase is experience in the meaning of those representations allowing users to become more system-independent. 'Direct manipulation is an attempt to bring activity to the concrete operational stage or even to the preoperational stage, thus making some tasks easier' says Schneiderman. It provides a simple model for human cognitive activity, where the use of direct manipulation can attract users in interacting with a computer.
The main contribution Schneiderman made is pointing out the necessity of cognitive science and psychology in the field of HCI, and its importance in creating more attractive and comprehensible opportunities within HCI. A task he ascribes to designer of those systems in strong relation to the (potential) users of these systems.
In continuing on this theory, Lucy Suchman tries to capture what exactly happens when models of cognitive science are projected upon computer science. In 'Plans and situated actions' a theoretical evaluation is given on cognitive science and HCI, where the statement is made that all action is fundamentally concrete and embodied. In an analysis of action, it is claimed that every action is situated, and, whether planned or not, this action is ad hoc.
In discussing interactive artifacts, questions concerning the distinction between artifacts and intelligent others, especially computer-based artifacts. Where artifacts used to only express their possible functionality, which s hard enough to design in the first place, now these computer-based artifacts facilitate uniquely interpersonal activities, due their possibility to communicate. Interaction between people and machines implies mutual intelligibility or shared understanding, where a kind of almost-aliveness is ascribed to the computational artifact: the machine. One can question here if this understanding is actually mutual, and in what ways this artifact really 'understanding' its surroundings, including the (augmented) human actor as agent, but more on this subject later.
In discussions on the mind and how intelligence can actually be described, it is stated that 'it is neither substantial nor insubstantial, but as an abstract-able structure with implement-able in any number of possible physical substrates. This would mean that intelligence is only accidentally embodied in the neurophysiology of the human brain. In decoupling reasoning

and intelligence form being purely a human thing, it opens up space for intelligent artifacts.' The behaviorist reaction was: action should be understandable by describing the relation betweenorganism and environment. The computer poses a new kind of 'environment', from this, AI emerged, combined with new theories of information. From al these new influences, the cognitive view derived: to relocate the causes of action from the environment that impinges upon the actor to processes in the actor's head. Cognition is not just like computation; it is computation. This has widespread implications, for example that of the development of robotics. Problem remains that, despite the sense that we as humans keep seeing computers as 'intelligent, the state of the art intelligent machines are still not 'smarter' than a young child. Whilst being a debatable statement, in the sense that the cognitive skills of a young child are far more complex than computers even now can 'imagine', the overall message is that in order to improve the dialogue, we have to look at other forms of intelligence besides the computational one (current views on AI and HCI state that mechanical intelligence for instance, could be an area to look into; where the embodied vs disembodied intelligence discussion is still very vivid, both parties agree that computational intelligence is not the way to go).

Point of controversy within interaction research and development is: should one model the interaction on the human-side, or on the computer side? And, moreover, modeling it on the interaction between humans (as an ideal, a utopia) or acknowledge that HCI is fundamentally different. An interesting insight here stems from Dennet, who states that the fact that we cannot understand the computer fully, makes interacting with it so interestingly, and makes us ascribe human values and expectation to this computer,. The dialogue is actually better constructed by not-knowing., by not being able to decipher its intended purpose. The question this evokes is whether this computational artifact should be self-explanatory and to what extend. Of course, the designer of the artifact must now think about possible behaviors and responses of the possible user, as well as the possible miscommunication or behavior that can occur. Must the dialogue, the interaction be predictable, orchestrate-able, and to what extend?

In moving away from the purely computational side of intelligence in HCI, Ullmer and Ishii are the first to introduce a framework that maps the dialogue of human-computer interactivity (1997) in terms of *tangible* interaction.



Ullmer and Ishii framework of human-computer interaction.

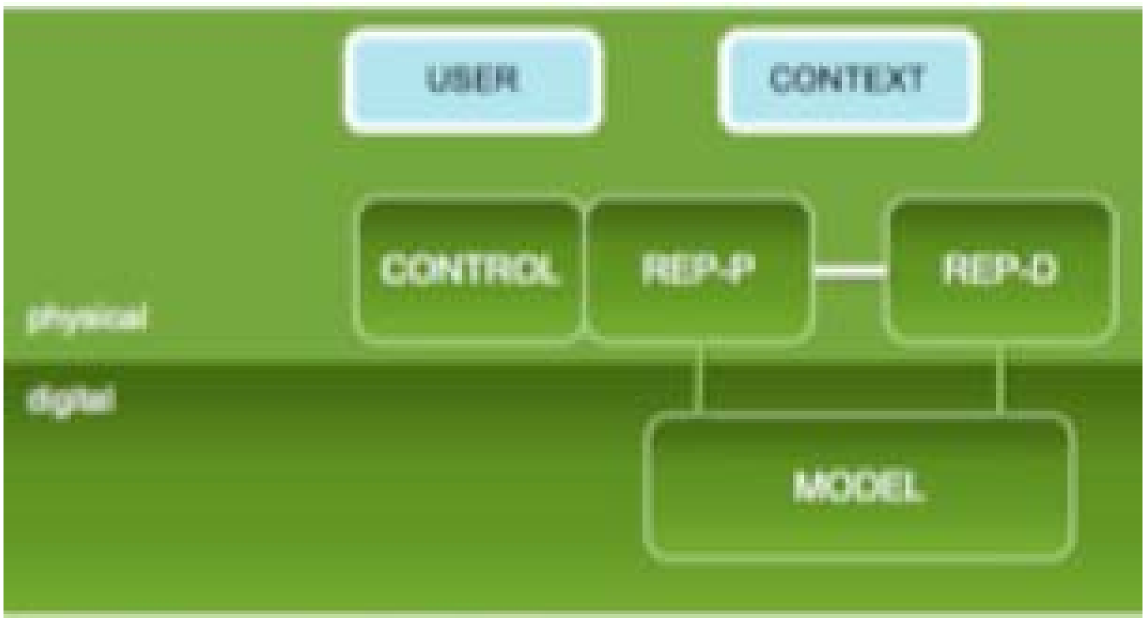
With the introduction of the model shown above, the existing model created to describe Graphical User Interfaces (GUIs in short) was altered into a model that maps the flow of Tangible User Interfaces (TUIs in short). In this new model, control-representation (physical and digital) are carried over, while the "view" element is divided into two subcomponents. "The "view" notion is added with physical representations, for the artifacts constituting the physically embodied elements of tangible interfaces, and with digital representations for the computationally mediated components of tangible interfaces without embodied physical form". With also mapping 'tangibles, it is meant that physical object used to hold- and manipulate digital data have a representational value, besides their control-value (where the example of the mouse, for instance, clearly fails to communicate its representational value). This interaction model provides a tool for examining several important properties of tangible interfaces (is there something as a non=tangible interface, one might ask).
three relationships are mentioned concerning this physical representation:
- Physical representations (rep-p) are computationally coupled to underlying digital information (model).
- Physical representations embody mechanisms for interactive control.
- Physical representations are perceptually coupled to actively mediated digital representations. Tangible interfaces rely on a balance between physical and digital

representations. In defining representation, Ullmer and Ishii state that: ‘representation’ is a powerful term, taking on different meanings within different communities. They consider digital representations to be computationally mediated displays that may be perceptually observed in the world but are not embodied in physically manipulable form. This is, of course a debatable point: why would digital information be represented only visually, and only on-screen? An important notice is that tangibles also carry a physical state, with their physical configurations tightly coupled to the digital state of the systems they represent. Coupling artifacts with digital information, tangible interfaces afford a wide variety of associations between physical objects and digital information. Tangibles may be statically coupled or dynamically bound to computationally mediated associations including:

- Static digital media, such as images and three-dimensional (3-D) models
- Dynamic digital media, such as video and dynamic graphics
- Digital attributes, such as color or other material properties
- Computational operations, applications, and agents
- Remote people, places, and devices
- Simple data structures, such as lists of media objects
- Complex data structures, such as combinations of data, operations, and attributes

The artifacts embodying these associations take on a range of physical forms, from generic to highly representational. Ullmer and Ishii also introduce the *phycon*, (physical icon) as an important category of tangibles and their relation to making the interaction more logical, more understandable in the translation of graphical icons that we are now slowly getting used to towards the emergence of physical icons, having a high level of representation. Within HCI context, Schneiderman’s three principles of “direct manipulation,” mentioned earlier while derived from the context of graphical interfaces, are also directly applicable to tangible interfaces. The first principle—“continuous representation of the object of interest is especially valuable. The contribution to the scientific and design contexts, the disciplines of cognitive science and psychology are concerned in part with “external representations.” Ullmer and Ishii state that these representations are defined as “knowledge and structure in the environment, as physical symbols, objects, or dimensions, and as external rules, constraints, or relations embedded in physical configurations."

With this framework, or model, a new field became known and accepted; also, a structures way was presented in which lots of research could be identified and mapped, showing its strengths and weaknesses.. However, one could argue that by clearly stating the digital as well as the physical representation of data in the physical world, options are excluded, like that of feed-forward (a digital action triggering a physical response) for instance. On the other hand, theorists like Kittler quite convincingly state that there is no software, because ultimately every digital action can be eventually traced back to transistors and capacitors, to a change in voltage.



Alteration on model

Back to mapping the dialogue of interaction, Hornecker et al. criticize this framework quite strongly. The figure above shows a current variation on this model, stating that the old model still lacks the involvement of the context in which these interactions take place. Moreover the state of the user is also still missing. By this it is meant that user plus context combined can set a whole different scope of 'rules' of representation that needs to be taken into account.

Within HCI a significant change is taking place during the last decade; we are shifting away from a traditional setup where one person is interacting with one computer, to one where the world becomes the interface.

This is where the new paradigm introduces itself: where computational power moves away from the traditional setup and moves itself into 'the world', the question of representation of data and the way in which this data is manipulated asks for a new way of treating this representation. In an Internet of things, how are these things going to talk to each other? And how are the user and the context involved in this conversation?
Hornecker et al. introduces a new framework in their paper ' getting a grip on tangible interaction: A framework for Physical Space and Social Interaction.
The authors propose a new approach to Tangible Interaction, stating that, until recently, attempts to develop frameworks have concentrated mainly on defining terms or on categorizing and characterizing systems. It is stated that the data-centered model (Ullmer and Ishii) as well as the taxonomy approach both deriving from a HCI background, provide a basis for TI, but give too narrow a view on what is happening:
"While supporting structural analysis, mapping out the design space and detecting uncharted territory, these offer little advice when designing for real world situations and seldom address users' interaction experience. Despite many interesting explorations of technical options, there is still a need for conceptual frameworks that unpack why 'tangible interaction' works so well for users". Furthermore, the authors quite baldly state that the "research community lacks concepts for analyzing and understanding social aspects of tangible interaction and design knowledge on how to design for social interaction and collaboration". As an alternative, it is proposed to view tangible interaction from a wider perspective, integrating a multi-disciplined array of research. Mentioned are 'rich interaction' research in product design, interactive arts and architecture as well as the classical HCI view on tangible interaction.
"*We have chosen to use 'tangible interaction' as an umbrella term for this field, drawing together several fields of research and disciplinary communities who can profit from each others' distinct perspectives and knowledge. Tangible Interaction, as we understand it, encompasses a broad range of systems and interfaces relying on embodied interaction, tangible manipulation and physical representation (of data), embeddedness in real space and digitally augmenting physical spaces"* [Hornecker et al.]

Current discussion

Most challenges in the near future concerning ways of orchestrating the dialogue is that it is represented in (at least) two realms; the physical and the digital. Where these two come together lots of things happen, especially in case of a networked situation, where digital data can be represented and manipulated on multiple artifacts and between multiple users interacting at once. The great advantage to moving away from the screen is that we can move away from the world of metaphors (like the desktop metaphor on screen) to direct couplings of meaning and action.

Discussion have, until recently, mainly focused on the intelligence part of the computational side within HCI, stating that eventually, the computer will be as smart as a human. This techno-utopian view however, is easily dismissed. In the classical view, it is attempted to tackle the problem of acting in the world through an "objective" description of the world. We (as intelligent humans) try to understand and describe the world from the outside and then we try, using this description, to provide knowledge to the system to help the computer to figure out, what it should do. This objective view of the world considers both the environment and the body of the system from the outside. A translation is needed from the information from the sensors into the abstract scheme of knowledge that the (often) engineers provide it with. This problem, creating a mapping between the formal representation and the sense data, is tricky. A second problem is that it is extremely difficult to make reliable abstract descriptions of the (messy) aspects of reality. One can describe the shape of an egg, for instance, but how does one describe formally what happens if someone is breaking an egg? In the embodied view, the emphasis is on the fact that the behavior of the system is a reaction of the system on its environment. The complexity of the intelligent artifacts behavior therefore does not necessarily imply a complex internal mechanism, but a consequence of complexity in the environment.

In this view, the action, and its situated-ness, as stated earlier, holds better options for really creating a (possibly projected) intelligent and meaningful interaction between humans and computers. In shaping, controlling and improving the way we interact and expect things of our seemingly increasing intelligent environment, the discussion is now moving towards a mapping and implementation of embodied intelligence and physical representation. Where cognitive science, psychology and arts have already mingled in, maybe biology and natural sciences are next. As the names of research centers alter form "Augmenting Human Intellect, to Institute of Bits and Atoms, we see a development from trying to unravel and model the human mind towards accepting and mapping the hybrid world of the digital and the physical, looking at its differences and similarities.

Conclusion

Via different texts reviewed in an almost chronological way, the attempt of this paper is to give a short, dense overview of the different angles and approaches within HCI during the short history of the computer, and the personal use of this computer. Moreover, clues are given on the many different angels of looking at human-computer interaction and the relevant issues concerning the creation of this human-computer dialogue.

Within this dialogue, a lot has changed; from the creation of the first computer, to the development of what can be called 'intelligent artifacts' – not only a computer in the traditional sense, but moreover all kinds of objects and tools we use in our daily environments become intelligent, show behavior.. This behavior is crucial in determining how we interact with these objects. This behavior created a whole new layer of possibilities in interaction, but with this also a much more complex design task. If the model of using metaphors was already debatable in graphical user interface discussion, focusing only on human-screen interaction, with the moving away from screen to the world interfaces and the introduction of tangible interaction, the use of metaphors becomes even more debatable. Is the designers' metaphor understandable to the end user? From this point on, a shift is taking place in academic fields; from computer scientist looking at 'pure' functionality, cognitive science, psychology, but also art is becoming involved in thinking about the 'user experience' of dealing with intelligent artifacts. One can ask whether every interaction should be 'fun' or 'attractive' as now is the paradigm. What expectations do we have from the systems that surround us, and how predictable must these expectations be? In talking, interacting with my surrounding, do I not want to be surprised, amazed or eased? An important aspect in future human-computer dialogue aspects is the insight of non-transparency; of not exactly knowing what is going on, where possibly the projection of intelligence on an artifact *is* the intelligence of the artifact.

References

Tangible Bits: Towards Seamless Interfaces between People, Bits and Atoms
Hiroshi Ishii and Brygg Ullmer
MIT Media Laboratory , Tangible Media Group

Tangible Bits: Towards Seamless Interfaces between People, Bits and Atoms
Hiroshi Ishii and Brygg Ullmer
MIT Media Laboratory

Getting a Grip on Tangible Interaction: A Framework on Physical Space and Social Interaction
Eva Hornecker & Jacob Buur
Interact Lab, University of Sussex
MCI, University of Southern Denmark

The Six Elements and the Causal Relations among them
Brenda Laurel
Computers as Theatre, 49-65, 2nd ed. Reading, Mass.: Addison Wesley, 1993

Plans and situated actions; The problem of Human- Machine Communication,
Lucy A. Suchman
Cambridge University Press 1987, 2nd ed.

Direct Manipulation; A Step Beyond Programming Languages
Ben Schneiderman
IEEE Computer 16(8): 57-69, August, 1983

"Put-that-there"; Voice and Gesture at the Graphics Interface
Richard A. Bolt.
Computer Graphics 4(3): 262 – 270 July 1980

Responsive Environments

Myron W. Krueger

AFIPS National Computer Conference Proceedings 423-33 Montvale N.J.: AFIPS Press

1977

A Research Center for Augmenting Human Intellect

D. Engelbart and W. English

AFIOS Conference Proceedings 33, part 1, 395-410. Fall Joint Computer Conference 1968