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Re-think About Human Computer Interaction! Need of the hour

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Abstract

As human life increasingly relates to and relies upon interactions with computer systems, researchers, designers, managers and users continuously develop desires to understand the current situations and future development of human computer interactions. The development of the human/computer interface has many facets and it can be described as the point of communication between the human user and the computer. The current generation of devices and presentation tricks has provided a basis for experimentation but a next generation of interface tools needs to be developed that is less centered on available technology and more on the basic needs of information communication. The progress and productivity of high-wage countries do not any more depend exclusively on the technological innovation. Increasingly, the most decisive part is the quality of the human technology interface, and the extent to which technology respects cognitive, affective and communicative needs of humans. This paper outlines the basic need to rethink about Human Computer Interaction and various socio-technical challenges of future Human Computer Interfaces.

Keywords: *Computer, Communication, Development, Human, Interaction, Interface, Technology, User.*

1. Introduction

The electronic world is starting to become an interesting place. From the comfort of our office or home computer, we can read the newspaper, check stock quotes, play interactive games and find factoids on more topics than we ever thought we were interested in knowing about. We can avoid the crowds at the mall by shopping electronically for everything from salami to sweaters and when we must venture outside, we can book our airplane reservations and rental cars without having to deal with anyone's automated call distribution system. While this world seems like a very nice place to live, it is a very nice place-it brings with it a series of compromises and constraints that reduce the manipulation of information to the presentation of data. The 21st century will confront us with completely new generations of technologies, services and products based on computer technologies. In the next decennia new generations of interfaces have to master fundamental societal and technological challenges like a society with an increasingly aged work force, short technological life cycles triggered by fast changing technological systems and resulting in fast changing mental models of technology, an increase in the complexity of technologies to be handled by divers skilled workers, understanding of invisible technology. For high-wage countries, which are characterized by competitive production systems and a high pressure to succeed, it is a fundamental question how technology and technological interfaces will meet these challenges. Current trends like ubiquitous embedded system technologies, increasing user diversity, fast changing technical environments promotes human computer interaction research to a key discipline of the century. The flow of information between the human and computer is defined as the loop of interaction. The loop of interaction has several aspects including task environment, machine environment, areas of the Interface, input flow, output, feedback. Human-Computer Interaction (HCI) concerns the design, implementation and evaluation of interactive computing systems for human use. It is a multidisciplinary science, touches computer, psychology, sociology and anthropology, industrial design, ergonomics and linguistics. For computer science, HCI focuses on the interaction between humans and the computational machines. HCI goal is to produce usable, safe, and functional systems. HCI, such as direct manipulation of graphical objects, mouse pointing, windows have changed

computing fundamentally. Human-computer interaction (HCI) is an area of research and practice that expanded rapidly and steadily for three decades, attracting professionals from many other disciplines and incorporating diverse concepts and approaches. To a considerable extent, HCI now aggregates a collection of semi-distinct fields of research and practice in human-centred informatics. However, the continuing synthesis of disparate conceptions and approaches to science and practice in HCI has produced a dramatic example of how different paradigms can be reconciled and integrated. In general Human-Computer Interaction is one of the key issues for information systems.

2. Evolution of Human Computer Interaction

Human-computer interaction (HCI) is an area of research and practice that emerged initially as a specialty area in computer science. Early HCI sought to develop synergies between cognitive science and cognitive engineering. In 1930, in Russia, the first human factors analysis of aircraft cockpits appeared. In the 1950, human factors became key issues worldwide (U.K., France, Germany, Sweden, Netherlands, USA, and Japan). The introduction of quantitative modelling of human behaviour, the formal description of psychophysical processes and cognitive functioning by constitutive theoretical approaches (e.g. signal detection theory, working memory, Fitts law, information theory) was another step forward, enabling the quantitative prediction of human behaviour and work productivity. In 1957 the Human Factors Society and in 1961 the International Ergonomics Society was founded. Both world-wide acting institutions formed the community and are influential and active until today. With the increasing automation in the 1960 onwards, a further keystone was the introduction of standardizations, legalizations and international certifications of health and work safety all over the world. During the 1980s a rich reciprocal relationship was developed. In areas like user modelling, HCI directly applied key cognitive science theories to the design of command languages and information visualizations. Parallel to the penetration of personal computers in working and private areas, in 1982, the Association for Computing Machinery (ACM) launched the International Conference of Human Computer Interaction (HCI), until today the leading conference on human computer interaction. The research field HCI has multidisciplinary roots from the very beginning, involving and addressing different disciplines, including industrial engineering, computer science, psychology, sociology, medicine, and linguistics. Earlier ergonomics, health and safety issues as well as humane working environments were key aspects. With the increasing maturity of technical systems, and standardization efforts, which assured a basic quality standard, health issues were less prominent. Instead, the prediction of human performance became a major research topic, as well as the productivity of human work in terms of effectiveness and efficiency. In the 1980s and 1990s, two parallel phenomena can be observed: On the one hand, the overarching introduction of personal computers and a productivity-related research, on the other hand, a boom of research dealing with technology acceptance. Meaningfully, both research streams were acting separately, without much awareness for the other. While the one mainly concentrates on the usability of a technical system, the other deals with the approval, favourable reception and ongoing use of devices, exploring the relation of using motives, cognitive and affective aspects towards the respective technology.

3. Meaning of Human Computer Interaction

Human–computer interaction (HCI) means the study, planning and design of the 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, characters or objects displayed by software on a personal computer's monitor, input received from users via hardware peripherals such as keyboards and mouse, and other user interactions with large-scale computerized systems such as aircraft and power

4. Definition of Human Computer Interaction

According to Association for Computing Machinery (ACM), human-computer interaction can be defined as "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."

5. Nature of Human Computer Interaction

Since human-computer interaction studies a human and a machine in conjunction therefore 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 factors such as computer user satisfaction are relevant. Engineering and design methods are also relevant. Due to the multidisciplinary nature of HCI, people with different backgrounds contribute to its success. HCI is also sometimes referred to as man–machine interaction (MMI)

6. Need of Human Computer Interaction

A need arises to design systems that minimize the barrier between the human's cognitive model of what they want to accomplish and the computer's understanding of the user's task. Professional practitioners in HCI are usually designers concerned with the practical application of design methodologies to real-world problems. Their work often revolves around designing graphical user interfaces and web interfaces. Researchers in HCI are interested in developing new design methodologies, experimenting with new hardware devices, prototyping new software systems, exploring new paradigms for interaction, and developing models and theories of interaction.

7. Human Computer Interaction Vs Human Factors

HCI differs from human factors that with HCI the focus is more on users working specifically with computers, rather than other kinds of machines. There is also a focus in HCI on how to implement the computer software and hardware mechanisms to support human-computer interaction. Thus, a human factor is a broader term; HCI could be described as the human factors of computers - although some experts try to differentiate these areas. HCI also differs from human factors in that there is less of a focus on repetitive work-oriented tasks and procedures, and much less emphasis on physical stress and the physical form or industrial design of the user interface, such as keyboards and mouse.

8. Requirements for future Human Computer Interaction (HCI) Approaches

8.1 Re-think Paradigms

A long time HCI has been discussed from a dominantly functional perspective. According to ISO 9241, the pragmatic aspects of technology, covered by the term "usability", are measured by effectiveness (how successful is the interaction), efficiency (how fast is the interaction), and satisfaction (how satisfied are users when interacting with the interface). Though, facing the complexity of future interface designs as well as an increasing diversity of users, contexts, and technology types, the concentration on pragmatic aspects falls short. Traditional approaches and human factors practices usually do not reflect the importance of (positive) emotions. We have reached a turning point of HCI, which requires a broadening of the focus and include emotional or affective designs. The relationship of users and technological product is of importance and the making sense of user experience. Increasingly, studies show that users not only desire more than the mere functioning of technology, but also prefer interfaces with a high social value. Beyond affective HCI, which is not yet included as an inherent component of design, we state another missing part i.e. communicative usability and the question how linguistic and semiotic means may contribute to a transparent and pleasurable dialogue between humans and interfaces. Communicative usability deals with two dimensions—the communicative quality of the human-computer interface as well as the quality of user support tools (e.g. training, manual, tutorials). To date, communicative usability is not seen as an inherent part of HCI, even though we all know from daily experience that the communication with technology is one of the most sensitive parts in HCI. Users are frustrated when confronted with unreasonably structured information, an inappropriate naming with unclear or even unknown vocabulary, vague instructions, inscrutable dialogues, and missing feedback Human-centered designs should learn from what we know about human-human communication as first order approximation of information transfer and adopt this knowledge. A future challenge is to investigate which modality fits best to which task and goal. Disciplines like linguistics, technical communication, or psycholinguistics offer a profound knowledge of how humans use language to describe their view on the world, to interact with each other and how humans deal with social and technological environments in order to solve problems and to learn.

8.2 Re-think Methods

The communication and interaction within and across HCI-related disciplines is characterized by misunderstandings, misbelieves and misconceptions. Partly, disciplines use different terms for the same thing (e.g. ergonomics and human factors), or they use the same or similar terms for different things (e.g. *HCI* for Human Computer Interaction vs. Human Computer Interface). Another distracting phenomenon is resulting from the fact that disciplines are investigating the very same topic with different foci and

different underlying theoretical and methodological framework. Each discipline is convinced to do the right thing and to do it in the most valuable way. Different disciplinary languages, value systems, and scientific approaches build up barriers for understanding and communication on a par with each other. Another factor aggravating the missing connection is the fragmentation within disciplines (e.g. cognitive, industrial, system and/or computer ergonomics). An expert in one subfield of a discipline is unlikely to be an expert in the other. Additionally, the disciplinary fragmentation makes it difficult to overview the richness of disciplinary research objects, theories, approaches, and methods. The challenge of future HCI approaches will be to create an effective cooperation within and across disciplines resulting in a multidisciplinary mindset and a multidisciplinary toolkit of methods.

8.3 Re-think Design

In fact, it is an ongoing discussion whether design approaches should direct to a "design for all" or, rather, to a differential approach. The design-for-all approach claims that HCI interfaces should be designed in order to meet requirements and needs of all users, providing universal access. This approach relies on empirical evidence, that a design for all approach is indeed feasible. In contrast, the differential design approach claims that HCI designs should focus on the "diversity" of users, using contexts, technology types and domains. The "design for all" approach is focusing on human universals, thus the functioning of basic senses, cognitions as well as basic emotions. The differential design is focusing on the specifics, determined by the social, cultural context as well as individual needs. HCI interfaces meeting demands of universal design are harmonized with information processing and assure a basic fit of technical interfaces to the persons which use these interfaces. As using contexts are determined by many other factors in addition—fun, aesthetics, experience, gender, cultural diversity, trustworthiness, security, safety, intimacy, individual abilities—differential design approaches assure users' satisfaction, acceptance and the contextual, adaptive and individual fit between humans and interfaces.

8.4 Re-think Users

As opposed to the past, when mostly sophisticated and technology prone professionals were the typical end-users of technical products, now broader user groups have access to technology. Still, the development of technology seems to be limited to dominantly young, technology experienced, and Western, middle- and upper class males. Although the vital importance of ensuring that the technology produced is both usable and appropriate for a diverse user group, recognition of the importance of diversity is only slowly influencing mainstream usability studies. Design approaches thus have to undergo a radical change taking current societal trends into account, which have considerable impact for the inclusion of a diverse user group. *Aging:* A first trend refers to the profound demographic change with an increasingly aging population across many nations. According to census data in 2050 more than 30% of the population will be 65 years and older. Increasingly more and older adults will be confronted with a broad range of technology, and urged to understand, learn and use it. Older users face difficulties in learning and using new computer applications. Contrary to current stereotypes, according to which older users are unable or unwilling to learn new technologies; they are indeed interested to become acquainted with new technology. However, older users do have higher demands on usable interface designs. Up to now, HCI designs are often realized without considering the abilities and needs of this user group. *Experience with technology:* The second trend is the ongoing diffusion of technical devices in all parts of daily life. Applications like electronic services are deeply integrated into daily life. Although these technologies are supposed to be accessible to everyone, a gap between those, who are "computer literate" and those, who are not (predominantly older users) is emerging. It should be kept in mind that older users differ considerably with regard to their needs, abilities and competencies. In order to address elderly users as a growing market segment, age-sensitive interface designs are needed. Age-sensitive HCI solutions allow user of different ability levels to interact with new technical applications. *Mental model of technology*: As a third trend, the technology itself has changed considerably over time: At the same time, technology innovation cycles become increasingly faster. The trend described is aggravating the situation especially for older adults, as the understanding of how technology works is to a large extent formed by upbringing and socio-cultural factors. Older adults were educated in times when technical devices were far less ubiquitous and complex. A mental model of how technology works, built in a former time, should interfere with, or at least should not be sufficient for, proper interaction with devices currently available.

8.5 Re-think Context

Interface design is strongly context-related. Human beings do not use a single technology in isolation. They use technical artifacts as part of a complex situation. The components are interrelated— contextual factors are influencing how humans are acting with technology; the use of technology modifies the embedding context. The

term ‘context’ covers a broad range of factors. They form a rich contextual framework including the professional or personal workplace as part of an embedding organizational framework, domain, culture, and society. A good interface design requires a broad understanding of contextual aspects as well as their interplay. HCI products must be seen in their relationship to political, economic, and legal constraints. A clear shortcoming of current HCI research regards the discussion of the interaction of technology, society and culture. Up to now there is a notable lack of knowledge on how society and culture affect the design of technology, and HCI as part of it. “Although culture has recently been recognized as one factor in interface design, CS and engineering are generally thought to be culturally neutral”. Otherwise “technological systems are socially produced, and social production is culturally informed”. Therefore, the design of technologies should fit to a certain culture and society. Cultural influences can appear in different ways. Research shows that the reception and evaluation of interface designs may be influenced by their underlying mindset or philosophy. In the case of Western websites, the design and the reception are reflected by different influences (e.g. Bauhaus’ “form follows function”, constructivism). In contrast, Chinese Web design criteria are oriented to the “principle of fullness”, an integral part of Chinese folk culture. Cultural aspects concern language-related issues, e.g. the use of pictograms and icons. Since standardized designs are highly desirable but intricate on global markets, the understand ability of icons, beyond national language boundaries and cultural contexts is of high importance. There is empirical evidence that most icon designs rely on analogies that may not exist, or may have different connotations outside the western world. A typical example is the—within European cultures—widely known icon representing a slashed musical note, which indicates that a mobile phone is in silent mode. While this icon is perfectly understandable within western cultures, the icon is completely misunderstood by Indians, because traditional Indian music does not use written symbols for music. Thus, if we aim at a culture-fair interface design, integrating and addressing users from different backgrounds, we should also integrate the knowledge of other cultures. User around the world may differ in perception, cognition and style of thinking, cultural assumptions and values. For example, American tends to classify things on the basis of functions. Their ways of thinking are analytical and abstract. Chinese tends to group things based on their interrelationship and thematic relationship; their ways of thinking are synthetic and concert. If different cultures (e.g. collectivist vs. individualist societies) require different interfaces, it is reasonable to assume that this must have consequences for usability methodologies and the usability evaluation process. Trends like ubiquitous computing and the possibility to connect devices and networks with other devices and networks change our personal and professional lives substantially. New approaches emphasize that user-centered research and design must consider, how new technologies and services may influence and how they change the environments, in which they will be used. The challenge will be to include ethical, personal and wider societal concerns into the design model by understanding human values. “Taking into account human values, therefore, will be a very different undertaking compared with seeking to attain the design goals of efficiency, effectiveness and utility.

8.6 Re-think Tasks

In traditional human-centered HCI approaches the category ‘task’ and related methods like task analysis are highly relevant components. In order to design a user interface—meeting the user’s needs—the designer must understand for which tasks one will use the system for and how they will be performed. Terms like ‘functional’, ‘usable’, ‘learnable’ and ‘efficient’ are directly related to the task category. In our opinion the concentration of tasks is not going far enough; it should be more fine-grained. The perspective focuses too much on the isolated use of a certain technology. As we mentioned above the use of a technology is part of a complex situation and overarching interests. Tasks are the result of former decisions, directed by superordinated individual as well as institutional goals which can be competing. For example, somebody is consulting an expert portal to be sure (superordinated goal) that they are doing the right things. With this intention they are searching for information (task). They are not only interested in easy to use search facilities but also in other aspects linked to their overarching goal like trustworthiness of the information they will get. New approaches are increasingly considering that technologies are no longer seen as purely functional and rational problem-solving. Also technologies become more and more an integral part of behavior and living spaces. A deeper insight in fundamental human goals is needed, but also—context-related—culturally ethically and socially adapted goal hierarchies as well as societal ways of interacting, thinking, working and living.

8.7 Re-think Technology

There is some evidence that the definition of a good user interface is closely related to the technology type in question and its problem-solving potential. Up to now HCI and usability research has shown little attention for the interrelation of technology type and user interface design. In contrary, a short view on the very fast growing number of computerized interfaces and their increasing diversity

makes it quite clear that this must have profound effects on the design of human computer interfaces. Innovations like hypertext, Internet and graphical user interface, allowed the creation of new applications, platforms and services that now dominate our private and professional life. A fast growing sector deals with smart clothing (wearable), and hidden technology. A delicate field is the augmentation of human senses, mind and body, as it touches ethical questions as well as the sensitive trade-off between technical feasibility and usefulness on the one hand and the protection of intimacy and privacy on the other. Another relevant question is the question of universal and specific features of technology as well as the harmonization between both requirements. Different technologies, tasks and purposes may require different interface solutions.

9. Future Challenges for Human Computer Interaction (HCI)

Future HCI demands should pick up the shortcomings existing so far.

9.1 HCI education

We need an integrative HCI education, in academia as well as in advanced trainings. The complexity of HCI challenges requires inter-, trans- and multidisciplinary approaches, realized in new educational programmes (HCI Master of Science). A HCI master education should not only train a comprehensive understanding of different disciplinary frameworks and paradigms, it should also direct to a transdiciplinary school of methods.

9.2 HCI research

Interdisciplinary and transdisciplinary research involves a comprehensive toolkit of models and methods. We need research frameworks integrating different types of methods, tools, and data types. Another indispensable requirement is the willingness to discuss traditional, within disciplines well-established mindsets and the openness to broaden these approaches by other approaches, perspectives and methods.

9.3 HCI multidisciplinary development

The multidisciplinary development of HCI over the last twenty years, that demands further need for advanced learning models, is itself a bigger challenge. Pedagogical models employed by many HCI and design programs will risk becoming increasingly short-sighted if they do not provide appropriate knowledge domains that can account for understanding design, social context and business strategies in addition to computing.

10. Findings of the study

- Human Computer Interaction (HCI) is a knowledge based approach to enhance and support communication between humans and computers.
- The system architecture of HCI has an explicit communication channel between the humans and hardware and an implicit communication channel between knowledge base and computer stored knowledge.
- HCI is of central value for effectiveness, efficiency and user satisfaction.
- Through HCI, the interaction and relationship between humans and computers is one of the prominent research focuses, as well as a human-centered interface design, covering both, input and output mechanisms.
- In HCI, information technology can be used as a means for accomplishing tasks.
- The future of HCI will be determined more by our social motivations than by technical innovation.

11. Conclusion

Human Computer Interaction (HCI) means the study, planning and design of the interaction between people (users) and computers. The biggest challenge for HCI continues to be its struggle for credibility. Many of the tools and techniques that have been developed within HCI research cannot be scaled up to meet the challenges posed by industry and commerce. Empirical studies often rely upon biased samples of undergraduate psychology students. Their results cannot easily be applied to the multi-threaded, mobile, distributed environment of modern computation. Similarly, vast areas of interaction involving the elderly or the very young are neglected. Thus the need of the hour is to rethink about Human Computer Interaction.

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