

Human Computer Interaction: A Review

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Abstract

The article outlines various issues of great importance in context with the human computer interaction. The study of human computer interaction is young but is expanding day by day, it is a boundless domain which needs to be understood and implemented. The theoretical as well as the practical nature of the topic will enable the researchers and the designers to better frame the various harsh challenges faced by them today. This new study of HCI is a multidisciplinary subject and its study is not limited. Special focus has been made on, the Paradigms of HCI, various behavior models of HCI, the various research methods used for HCI, various challenges for HCI, relationship between HCI and E-commerce and related issues. The aim of paper is to make aware of a number of research methodologies for the disciplines to contribute to the study of HCI.

Keywords: Paradigms of HCI, Behaviour Models, Challenges for HCI Design

I. INTRODUCTION

HCI or the Human Computer Interaction is the term used to depict the technology usage and research designs for the purpose of defining various ways in humans can interact with the computers (or machines) and vice-versa. Humans can make use of various computational artifacts, infrastructures and systems and this the main area of study in HCI. Researches in HCI deal with designing various computer interfaces, implementing them, evaluating them and comparing them. The use of the term HCI initially started in late 70's. Various methods and theories have been discovered over these years on human computer use and for the conceptual frameworks for computer interface designing.

II. THE THREE PARADIGMS

Kuhn (1970) first used the term “paradigm” as a way to describe waves of research in a scientific field. Kuhn argued that a particular paradigm can be characterized by a common understanding of what phenomenon is being studied, the kinds of questions that are useful to ask about the phenomenon, how we should structure our approach to answering those questions, and how the results should be interpreted.[1]

HCI has three paradigms, namely: i) Human-Factors, ii) Classical Cognitivism/Information Processing Based and iii) Third/phenomenologically-Situated Paradigm.

- Human factors can be described as a pragmatic as well a theoretical approach for identification of various problems in industrial systems and ergonomics. In the context of HCI, it conceptualizes interaction as a form of man-machine coupling. Thus its goal is to optimize the fit between humans and machines; and the questions to be answered focus on identifying problems in coupling and developing pragmatic solutions to them. Appropriate disciplines for interaction are Engineering, programming and ergonomics. It has reduced errors, Ad hoc is OK, and Cool hacks are desired.
- As Grudin (2005) documents, CHI is more dominated by the Classical Cognitivism/Information Processing paradigm in which the central metaphor is that of the mind and computer as coupled information processors. The state of the computer (or human) is affected by the operations performed by the other. We can easily predict and optimize relationship between the two by just modeling their states. Just like “human factors”, work in this paradigm also starts by identifying a phenomenon or problem in the real world. But unlike “human factors”, here the phenomenon or problem is then abstracted to the form of a model, the more general the better. One power of this approach comes from the fact that the terms of the information-processing models hold within the computer, between the computer and the person, and within the person. Since the model is one of rational actors, operations can be measured in terms of the accomplishment of goals. Therefore, designs can be systematically evaluated against one another.[1] It provides us with Optimization, Generalization (wherever possible), Principled evaluation is a priori better than ad hoc, Structured design better than unstructured, Reduction of ambiguity, Top-down view of knowledge. Appropriate disciplines for interaction in this paradigm are Laboratory and theoretical behavioral sciences.
- Third/phenomenologically - Situated Paradigm is the paradigm that symbolizes the “interaction as phenomenologically situated”. This paradigm has various perspectives and approaches. Supporting the situated action and to make meaning in specific context are the main goals of interaction. Others are to answer the questions revolving around the way to complement formalized, computational representations and actions with the rich, complex, and messy situations at hand around them. Thus the three interlocking elements of the phenomenologically situated paradigm are: (1) focus on meaning and meaning creation, (2) based on human experience, and (3) therefore represented through multiple perspectives, and the relationship amongst those perspectives.[1] Since, here the emphasis, instead of single perspective, is on multiple perspectives so resultantly we have wide variety of approaches. The third paradigm thereby fulfills Kurt Lewin's (1951, p. 240) demand that we “draw on the totality of coexisting facts which are conceived of as mutually interdependent” to explain, predict, and influence human

behavior and experience.[1] Construction of meaning is intrinsic to interaction activity. Here, the goal is to grapple with the full complexity around the system. Appropriate disciplines for interaction in this paradigm are Ethnography, ethno methodology, ethology, action research, practice-based research and interaction analysis.

HCI has always been a hybrid discipline and therefore has used either the intersection or union of legitimate practices from its constituents. Thus the first paradigm defines legitimacy as measurable utility, the second paradigm as contrastive, and these are the standards to which third paradigm work tends to be held.[1]

III. BEHAVIOR MODELS

There are various behavior models for the HCI which have been broadly classified into Predictive and Descriptive Models. Various Predictive Models are:

- Keystroke-level-model (KLM)
- Throughput (TP)
- Fitt's Law

Various Descriptive Models are:

- Key-action-model (KAM)
- Buxton's three state model
- Guiard's model of bimanual skill

Here, we would discuss a bit about the Fitts' Law.

According to this law, human movement can be modeled by analogy to the transmission of information. Fitts' law is a model of human psychomotor behavior derived from Shannon's Theorem 17, a fundamental theorem of communication systems (Fitts, 1954; Shannon & Weaver, 1949). The realization of movement in Fitts' model is analogous, to the transmission of information. Movements are assigned indices of difficulty (in units of bits), and in carrying out a movement task the human motor system is said to transmit so many "bits of information." If the number of bits is divided by the time to move, then a rate of transmission in "bits per second can be ascertained. [4] This model has been widely adopted in various fields like kinematics and HCI. It has proved to be most robust and highly cited model.

The starting point for Fitts' law research in HCI is the work of Card, English, and Burr (1978). In comparing four devices for selecting text on a CRT display, the model provided good performance predictions for the joystick and mouse. More than 80% of the variation in movement time was accounted for by the regression equations.[4]

IV. RESEARCH METHODS FOR HCI

Since, HCI is a multidisciplinary subject which has grown out of various fields like computer science, psychology, social sciences, philosophy, cognitive ergonomics, organizational theories etc. So, a narrow approach for solving a problem probably won't work. Even if it works, it won't be the most appropriate approach for solving the problem. So, here is one of the research methods' for HCI and one of the methods for HCI in mobile system.

- "Model for Interaction Design Research in HCI" is a model to follow research through design presented first by John Zimmerman, Jodi Forlizzi, Shelley Evenson of the Human-Computer Interaction Institute and The School of Design Carnegie Mellon University. Designers following this approach produce novel integrations of HCI research in an attempt to make a right product. This model allows designer researchers to collaborate on an equal footing with HCI engineering and behavioral science researchers to make research contributions based on their strength. This methodology consisted of a
 - 1) Literature Review focusing on the design research literature.
 - 2) CHI 2004, Workshop held at the CHI conference in Vienna, focusing on clarifying the relationship between HCI and design. It lead to exploration of two distinct but complementary tracks: (i) role of design in HCI education and role of HCI in design education, and (ii) the role of interaction design research in HCI.
 - 3) Interviews asking various people about their ideas of what design is and what design research is in terms of HCI research.[5]
 - 4) Synthesis, Analysis and Iterative Modeling

The model provides five main benefits:

- it allows the HCI research community to engage with wicked problems that cannot be easily addressed through science and engineering methods.
- it feeds back technology opportunities to the engineers and gaps in behavior theory and unexpected behaviors to the behavioral scientists, motivating new research.
- it provides a new method for transferring knowledge produced in the HCI research to the HCI practice community, potentially increasing the likelihood this knowledge will move into products in the world.
- it allows interaction designers to make research contributions that take advantage of the real skill designers possess—reframing problems through a process of making the right thing.
- it motivates the HCI community to discuss preferred states and to reflect on the potential impacts research might have on the world.

The model has various applications such as XEROX reprographics, Phillip's vision of the future Project, and Apple Guides.

- "Mobile Research Methods for HCI" There are various methods available for research in the field of mobile HCI. According to Benbasat's, these are broadly categorized into:

A. Natural settings:

These category includes various research methods as follows:

- Case studies- Yin [12] defines a case study as “an empirical enquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident”. So, a case study is an empirical study of entities which are usually small in size.
- Field studies-A field study is the one which is done actually in “the real world” and data is gathered by observing the specific environments or conducting interviews.
- Action research-Action research deals with applying the scientific knowledge to the object that is being studied and evaluating results from it.

B. Artificial settings:

This category consists of only one method, i.e., Laboratory experiments. It means that the research on a particular subject is done in a laboratory or any other well defined environment for the particular subject.

C. Environment independent settings:

This category is further sub-categorized into:

- Survey Research- Information is gathered from asset of people in form of interview or questionnaires and then used to study about the subject.
- Applied Research- Researchers apply their capabilities of intuition, experience, deduction, induction etc and use them to study a particular topic. Various trials are done and on basis of success gained and errors found, the changes are made.
- Basic Research- This consists of the study of certain problems that do not have any specific study methods or solutions.
- “New Theoretical Approaches for HCI” The field of HCI is rapidly growing day by day and along with it researchers have found certain new approaches for HCI which are theoretical in nature and have a very limited impact on the interaction design. These approaches are as follows:

D. The Ecological Approach:

A main focus in the original ecological framework was to analyze invariant structures in the environment in relation to human perception and action. From this framework two key related concepts have been imported into HCI: ecological constraints and affordances. Of the two, the latter is by far the most well known in HCI.[2]

E. The Activity Theory Approach:

According to this theory, the cultural practices are described in terms of “activities” in various contexts such as developmental, cultural and historical; in which they occur. This theory was bought into HCI as it was considered useful for thinking about the design of user-interfaces and computer systems based in the work settings in which they were to be used (Bødker, 1989).[2]

F. The External Cognition Approach:

The approach of this theory is to provide a set of independent concepts that attempt to map a theoretical space specifically in terms of a design space.[2]

G. Distributed Cognition Approach:

The distributed cognition approach was developed by Hutchins and his colleagues in the mid to late 80s and proposed as a radically new paradigm for rethinking all domains of cognition (Hutchins, 1995).[2] Some researchers have said that in terms of its application in HCI, this technique is much harder to apply than other ones. It examines the way in which the form and variety of media currently representing the information might be transformed and the consequences of this for a work practice and then informs the design.

Various other approaches are listed as follows:

- The Situated Action Approach
- The ethno methodological approach

V. ELECTRONIC COMMERCE AND HCI: THE RESEARCH ISSUES

In the modern era of technology, when everybody is having smart gadgets and is short of time, the electronic commerce (or e-commerce) is the easiest way to get your products at your doorstep on a click. But there are certain issues in electronic commerce:

A. Web Usability:

Web usability is the way in which we use the web for our requirements. Even today, there are a lot of people who find problem in surfing the internet. People face difficulties in browsing the web and finding the appropriate website for their use. So, the focus should be to provide an atmosphere on web which has ease of navigation and search.

B. Designing for Web Commerce:

Nielsen (2001) asserts that poor Web site design is a major factor affecting the profitability of Web-based retailers. He describes a recent study in which users made 496 attempts to perform various tasks on 20 large and small e-commerce sites – with only 56% of those attempts being successful.[7] They are not able to find their specific products on the websites, they face issues in payment and even sometimes they accidentally click on the Ads and then get confused what to do. So, the websites should be designed in a user-friendly manner in order to increase the business.

C. Trust in E-Commerce:

One of the reasons that people do not want to use e-commerce is “lack of trust”, i.e., they do not know personally the vendor and so they doubt while sharing their personal information or their financial information such as bank details for payment.

Thus, in order to succeed in e-commerce, online vendors need to begin with a user-friendly and trustworthy Web site so that users feel comfortable and confident interacting with it. The process of navigation and search on the Web site should require minimal effort, and the Web site should be designed in such a way that it facilitates product search within a short amount of time and provide users with a good sense of control over the interaction. Having a user-friendly Web site, by itself, is not adequate. It also needs to cultivate a climate of trust and confidence among its users.[7]

VI. CHALLENGES FOR HCI DESIGN

HCI is growing very fast day by day and along with the various technological advancements it has to face certain challenges too. In today's era, every product needs a user-friendly GUI (Graphical User Interface). The making of a user-friendly GUI is a difficult and time consuming task in HCI. The various challenges being faced in HCI design and its implementation are as follows:

- The first task in making a user-friendly interface is to know the user and the user's perspective of using the interface. Designers face difficulty in thinking from the perspective of the user.
- When the designers provide a single application for various type of users who need to use it in different ways, the complexity of the tasks as well as application increases.
- Various things need to be considered while designing an interface for HCI which include standards, graphic design, documentation, performance, Internationalization, time to program and test, high-level and low-level details, legal issues and various other factors.
- The various theories, guidelines and methodologies required to make a good user interface are not sufficient, they are just the basics.

One of the solutions to all these problems is Iterative Design approach. It facilitates going round and round through the whole design process again and again and makes any changes whenever and wherever required.

VII. CONCLUSION

In this paper, we have presented a review of the HCI, i.e, Human Computer Interaction. In this paper, we have presented the various paradigms of HCI. So far, we have there are three paradigms out of which the third one, i.e., “Third/Phenomenologically situated paradigm” is usually taken into consideration now-a-days. We have also studied a brief introduction of the various behavior models for the Human-Computer Interaction. We have talked about the various research methods of HCI and the issues being faced. From our study of various papers on HCI, we got to know that HCI is a very broad field which basically deals with the human psychology and how the psychology can help us make user-friendly computer interfaces. Researchers have found out many different ways for human computer interaction in a user-friendly manner, also keeping the complexity to minimum possible but still there are a lot of challenges and there is still a long way to go. Researchers are still working to find more ways to make interface more friendly and decreasing complexity to a much larger extent.

REFERENCES

- [1] The Three Paradigms of HCI: Steve Harrison, Department of Computer Science and (by courtesy) Art and Art History Virginia Tech 121 VTKW II 2202 Kraft Dr – MC 0106 Blacksburg, VA 24060 USA; Deborah Tatar, Department of Computer Science and (by courtesy) Psychology Virginia Tech 123 VTKW II 2202 Kraft Dr – MC 0106 Blacksburg, VA 24060 USA; Phoebe Sengers, Information Science and Science & Technology Studies Cornell University 301 College Ave. Ithaca, NY 14850 USA
- [2] NEW THEORETICAL APPROACHES FOR HCI: Yvonne Rogers Interact Lab, School of Cognitive and Computing Sciences, University of Sussex Brighton, BN1 9QH, UK; email: yvonner@cogs.susx.ac.uk
- [3] A Review of Mobile HCI Research Methods: Jesper Kjeldskov and Connor Graham, Department of Information Systems, University of Melbourne Parkville, Victoria 3010, Australia
- [4] HUMAN-COMPUTER INTERACTION, 1992, Volume 7, pp. 91-139 Copyright Q 1992, Lawrence Erlbaum Associates, Inc. , “Fitts' Law as a Research and Design Tool in Human-Computer Interaction”, I. Scott MacKenzie University of Toronto
- [5] Research Through Design as a Method for Interaction Design Research in HCI: John Zimmerman, Jodi Forlizzi, Shelley Evenson Human-Computer Interaction Institute and The School of Design Carnegie Mellon University
- [6] Research Methodsfor HCI: Anna L Cox UCL Interaction Centre UniversityCollege London, London, WC1H 0AP; Paul Cairns Dept of Computer Science Universityof York, York, YO10 5DD; Harold Thimbleby FIT Lab, Dept of Computer Science, Swansea University Swansea SA2 8PP; Natalie Webb Mâtau Ltd, Flat 41 Hargrave Mansions, Hargrave Rd, London N19 5SR
- [7] HCI RESEARCH ISSUES IN E-COMMERCE: Fiona Fui-Hoon Nah, College of Business Administration University of Nebraska – Lincoln and Sid Davis, College of Information Science & Technology University of Nebraska – Omaha
- [8] Brad A. Myers -Challenges of HCI Design and Implementation