Original Article

EMERGENCE OF HUMAN-COMPUTER INTERACTION: GLOBAL AND INDIAN PERSPECTIVE

Somya Khatri[1], Dr. Ritu Sharma[2]

[1]Research Scholar, School of Liberal Studies, Pandit Deendayal Energy University, Raisan, Gandhinagar - 382007, Gujarat, India

[2]Associate Professor, School of Liberal Studies, Pandit Deendayal Energy University, Raisan, Gandhinagar - 382007, Gujarat, India

Email: somyakhatri212@gmail.com

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Abstract

The purpose of this paper is to provide an overview of the historical framework of Human-Computer Interaction (HCI). The overview emphasises the historical achievements in the field of research while highlighting the relevance of HCI, its beginnings, and its growth on a global scale. In addition, the review focuses on the reasons why the subject of HCI emerged in India. It also covers the fundamentals of HCI, usability, and other related terms. The method used for this review article is based on literature search of journal articles, books, conference proceedings, websites, and online news related to the listed keywords. Given that HCI is becoming more and more integrated into our daily lives, it may be said that it will also be responsible for defining the future. It can be difficult for some users to imagine living without their devices because they have become an integral part of contemporary society.

Keywords: Human-Computer Interaction, usability, global level, history within India, user interface.

INTRODUCTION

HCI is the study wherein people use multifarious technological inventions with which they interface within their daily lives. In this field 'social & behavioural science' and 'computer & information technology' intersect to perform an ideal interaction amongst users and technology. (Kim, 2015) The gathering of elements from the field of computer science, cognitive psychology, and human factors lead to the origination of HCI. This area of practice and research emerged in the late 1970s. Given its brief history, it's hardly surprising to consider it as an area of specialty at its nascent stage.This branch of learning has interested professionals from plenteous domains and has also unified differing concepts and approaches. Presently, numerous researchers are delving into the field to study the relationship between human beings and machines, further leading it to become a prominent field of study.

The construct of HCI is based on the user, the computer, and the interaction. The factors that persuade the interaction with machines are first brought to the mind of the user who could be an individual or a group of individuals. These factors comprise sensory systems (sight, sound, and touch), age, culture, social differences, and education. Any technological device, digital platform, or software is constituted under the broad term computer. Interaction, which is the third aspect, pertains to the design components of technology. (Murphy, 2019) The fundamental objective is to develop technology that is usable and functional. For instance, a developer engaged in the development of software to inspire children to understand and grasp the concept of coding will have substantially different HCI considerations balanced against a designer building a program for dexterous coders.

For HCI to be effective, the interaction must be made compatible with human information processing capabilities. In the past, numerous cognitive architectures that incorporate learning about human information processing have been developed that can be applied to HCI. However, scientists, developers, and researchers are constantly trying to upgrade this by including all possible cognitive aspects which can help create elevated designs, further providing efficient and effective interaction between the user and the system.

Computers have been around since the 1940s, however, the interaction between humans and computers commenced in the latter part of the 1970s. (MacKenzie, 2012) This interaction made computers accessible to every individual, highlighting its usability

aspect. From the 1940s to 1970s, computers were considered extremely valuable and sophisticated, and beyond an average human being's comprehensive ability. However, this scenario quickly transformed and generated a result which scientists and computer engineers did not foresee. During the 1980s, computer systems became more accessible to individuals. This elevated the position of computers, transitioning their position from labs to people's desks at workplaces and even progressing into their homes. This shift came about because computers were made more usable, propagating the idea that technology should be usable or user-friendly so that an individual can have a simplified interaction. However, this brought to pass a novel cluster of design problems, wherein the concern displaced from what a computer could do; to how simple a task it could perform. This was the prerequisite for making computers a commercial success. And these computers had to appeal to and satisfy every type of consumer, from the most experienced to a complete novice.

This led to the development of the term usability, which refers to the ease of use or ease of access to an object, a tool, or a piece of technology; it is a component of the broader term 'user experience' and is also a key term in HCI. Usability describes a system's adeptness to permit users to conduct their tasks safely, effectively, efficiently, and enjoyably. (Lee et al., 2019) The lucidity and precision with which the interaction with a website or computer program is designed are dealt with by the usability construct of HCI. HCI and usability are becoming distinguishing features of the system development procedure, with an eye towards improvement and enhancement of system facilities, and to satisfy users' needs and necessities. It is indicated that HCI will come to the aid of designers, analysts, and users to distinguish the system needs varying between text style, layout, fonts, colour, and graphics, while usability will corroborate the system's efficiency, effectiveness, safety, utility, comprehensibility, ease of remembrance, ease in usage and evaluation, practicality and delivery of satisfaction to the users. Hence, HCI and usability are becoming the focal point of technological development. (Issa & Isaias, 2015)

As stated by Nelson and Norman's group, usability is manifested by five quality constituents including learnability which refers to the ease with which a user can execute basic tasks, the first time they encounter the design. Usability also allows for efficiency which represents the virtuosity with which a user can perform any task on a device, once they become familiar with its design. The third component emphasizes memorability which calls attention to the user's return to design after it is overlooked for a prolonged period and effortlessness with which proficiency can be reinstated. As per the fourth component, the number of errors made by the user as well as recovery from those errors is highlighted under usability. Lastly, the level of satisfaction and pleasure experienced when using the design is observed. (Nielsen, 2012)

Usability's eminence escalated instantly, because the need for technology that was efficient and effective was surging. Users wished for remarkably effective and easy-to-learn interfaces and developers became aware of the indispensable role of interface. Surveys unilaterally justify the fact that over 50% of the design and programming effort on projects is committed to the user interface aspect. (Myers & Rosson, 1992) HCI is of paramount importance for the success of products in the marketplace, likewise, the usefulness, safety, and pleasure of using computer-based systems are also considered. (Myers et al., 1996)

Relevance of Human-Computer Interaction

HCI gives importance to enhancing interaction between users and computers by making computers also uncomplicated, coherent, receptive, and intuitive. It navigates around the highly technical identifications of computer science; nonetheless in essence it's a people-oriented discipline. Myriad risks have catalyzed as a consequence of inadequate attention to HCI, and obvious disasters have entrained from taking no notice of it. Human Research Program (HRP) & National Aeronautics & Space Administration have underscored the risks resulting from meagre interaction with computers, as potential warning to health of the public, and its efficiency & performance in space. The insecurity resulting from inadequate usage of HCI at NASA includes eight prime contributing determinants in accordance with the Human Factors Analysis and Classification System (HFACS): 1) Requirements, policies, and layout processes, 2) Information assets and support, 3) Allocation of attention, 4) Cognitive overload, 5) Environmentally brought on perceptual changes, 6) Misperception and misinterpretation of the exhibited knowledge 7) Spatial disorientation, and 8) Controls & displays. (Holden et al., 2013) Provided these instrumental determinants can be effectively depicted through the utility of research, and if there is familiarity with these factors, the risk of human error will diminish to a large extent. On some occasions as reported by NASA, incidents ensued when these factors were disregarded in design. Additional research is required to develop crystallized methods for measuring HCI on long-duration missions.

The mechanisms with which humans interact with computers continue to press forward and Usability is the principal component that assesses how practical and convenient user interfaces are when applied. Climatically, what significance would technology hold if it cannot be utilized? As a result, Usability is the central concept within HCI. For people with an amateur understanding of usability, it stands for thinking about how and why people should utilize a product and its potential to accomplish the person's needs. The term is continually employed in conjunction with software applications and websites in information technology.

However, there is the possibility of using it concerning any product that is employed to execute a task (for example, a car dashboard, a toaster, or a desk drawer, a teapot)

The design aim of a product or technology can also be thought accountable for reconceptualising usability. Serviceability and security are of paramount concern when designing technical segments. However, effectiveness, efficiency, and indulgence in technology are also of great concern. Additionally, in conformity with the advent of digital commerce, design principles followed within HCI can significantly impact the efficacy or inefficacy of a device. HCI has become one of the overriding considerations for every single digital or tech provider, and this relatively new field is further adding to a multitude of career options.

Industries, where the applicability of HCI is observed, are countless. It is influential because computer software systems run our contemporary world. Industries like transportation, gaming, logistics, manufacturing, healthcare, hospitality, housing, and aviation to name just a few among many that incorporate technological interaction in solving human problems. At present, HCI is leaving no stone unturned to understand human fundamentals. Functional, beneficial, advantageous, attainable, and engaging user experience is the need of the hour. HCI experts are concentrating on accomplishing these goals for the good of society as a whole.

Inventive applications of information & communication technology impact numerous facets of life today. An extensive array of research work pursued in the sphere of Human-Computer Interaction presents how technology affects and intersects with social systems. It also highlights the concentrated domination of technology on the quality of life. To focus on the aesthetical design of technology, interaction with the contextual social system also needs to be extrapolated. One of the substantial core fragments of social systems is public policy. The relationship between public policy and Human-Computer Interaction research & practice is valuable to societal development ramifications, evidence-based methodologies to governance, & estimating urgencies of policy goals.

Medicine & healthcare presently are subject to extreme rapid technological changes. It is particularly crucial to design medical systems from the standpoint of users; medicine is also an important area of the economy. Therefore it is mandatory to formulate effective solutions, as well as comprehending and foreseeing the probable issues, which users can and do encounter. Human-Computer Interaction along with user interface administers a springing potential to assist the daily workflows in the department of medicine & healthcare. Lately, increasing figures of applications used in the service and hospitality industry take Human-Computer Interaction into account to administer the process of design and implementation.

Instead of long-term technological trends, acquiring a Master's degree specializing in HCI can unfold numerous career prospects for individuals. A graduate in HCI will be able to incorporate computational and technical skills in real-life contexts and will have the potential to work as an interaction designer, user experience designer/researcher, human factors engineer, front-end designer and developer, multimedia designer, and developer, to name just a few. One thing that is undoubtedly common to all these professions is the identification of user's needs, which can be done via several qualitative and quantitative methods, heuristic evaluation being one.

The term refers to an informal technique of usability evaluation in which numerous evaluators are provided with an interface layout and are requested to annotate it. (Nielsen & Molich, 1990) Nielsen (1993) and Rolf Molich are responsible for developing the method of heuristic evaluation, bearing in mind their long-standing association with consulting and teaching about usability engineering. Ten Usability Heuristics developed based on their work together were released by Nielsen in 1994 and were published in his book Usability Engineering. These heuristics that are responsible for solving problems & reaching a decision are considered fast and practical and are employed till today. (Nielsen & Mack, 1994)

In user experience (UX) design, experienced evaluators apply heuristic evaluation to comprehensively establish a product's/ design's usability. Some flaws which are overlooked by the design team are identified by specialists as they go through the heuristic evaluation checklist, which states that a system should be prompt in informing the user about its status. It also asserts that the system should be consistent for the avoidance of doubt over different icons, words, etc. (Wong, 2020) Additionally, the system should undertake the responsibility of preventing errors, which can be done either by dismissing conditions where errors become apparent or by notifying the users before they make any erratic move. Containing no clutter and including only relevant information for the current task is another requirement which the system should fulfil. Likewise, there are numerous heuristics or frames of reference which an industry expert can follow to facilitate interfaces in HCI.

An extremely positive impact on HCI due to recent developments in technology can be observed. Presently, interaction with computers using the touch screen, eye movement, voice commands, and hand gestures is possible. Traditionally, the principal objective of HCI systems was to indulge human users in administering an explicit or implicit task. However, by monitoring the existing situation, a shift can be noticed which directs towards interfaces that are not task-oriented but rather focused on the user's experience. Factors such as surprise, beauty, intimacy, or diversion of a system which are more subjective in nature are critically important. (Poppe et al., 2007)

Undoubtedly, the mechanism utilized to interact with computers has changed greatly over the past decade. Smartphones now offer a considerable amount of computing power which is remarkable. Such convenient devices have allowed for diversified interactions that are readily available. Talking about the future of these smart tiny devices with tiny screens which were initially designed for speech is going to go way beyond setting appointments and surfing the web with the help of a voice-guided user interface. (Bieller, 2021) The pace of implementation of speech recognition will be more than 80% because voice undeniably provides an unparalleled and universal approach for interacting with devices.

Additionally, a context-aware interface is a style of computing that utilizes situational and environmental information about people, places, and things and is used to anticipate immediate needs and proactively offer enriched, situation-aware, and usable content, functions, and experiences, will be particularly relevant for mobile phones. Should it be the case when mobile phones can decipher the location of the place of interest (i.e. café, restaurant, supermarket) they can provide information about complementary services offered. (E.g. preview of the music list available during service hours, comparison list referring to the pricing of products available in the supermarket)

The Emergence of Human-Computer Interaction: Global Perspective

The sphere of HCI is employed with design principles, as well as evaluation & execution of synergistic computing systems for usage by humans, and with research about notable phenomena surrounding them. (Hewett et al., 1992) It has been around for decades and has influenced nearly every area of daily life. Presently, numerous researches are delving into the study of the relationship between human beings and machines, and it has quickly become the most prominent field of study. The primary focus of these studies revolves around looking at the applicability of psychological science of perception, cognition, communication, & motivation in the technological domain, to provide an ideal user experience. Presently, the frontier of Human-Computer Interaction encompasses the planning, designing, and development of computer devices and systems which have additional intelligence and usability.

When thinking about technology, we tend to think about the future and forget about the past. Analyze today's ubiquitous Graphical User Interface (GUI) which enables the user to interact with the computer via the means of symbols, pointing devices, and visual metaphor. (Levy, 2018) It is well known that GUIs are modelled invariably after two innovative systems which include Xerox star, unveiled in 1981, and the Apple Macintosh, unveiled in 1984. In addition to this, it is known for its implementation in Microsoft Corporation's Windows operating system. However, the preliminary work for the establishment of these systems was undertaken in the 1960s and the 1970s. (Baecker, 1995) As a consequence, it can be authenticated that today's creative system can be accredited to the excitement effectuated by yesterday's imaginative speculation.

HCI research has proven to be exceptionally successful and has substantially modified computing. However, it took time for HCI to become a recognized field of research and development. As of today, roughly all software formulated depends on user interface toolkits plus interface builders. Further, the phenomenal growth of the World Wide Web is directly attributable to HCI technology; installing hypertext technology within the browsers allows users to navigate a link with a single mouse click. By that means, interface progression is the reason for prompting this exponential growth. (Myers et al., 1996)

The emergence of HCI can be traced back to the Second World War. Amidst that cataclysmic event, the formation of complex equipment which could be utilized by soldiers, pilots, and sailors that tested human capabilities was the pressing priority. Consequently, the enormous value was assigned to the area of engineering psychology. As indicated earlier HCI is certainly not a single discipline, but it is a merger of different fields, including human factors and ergonomics, information science, engineering psychology, organizational psychology, computer engineering, and cognitive science. Following the Second World War, aviation psychologists constructed the Human Factors Society. The outcome of World War II branched into two parts; first being the familiarity with the capability of computing, second being a continuing interest in behavioural specifications for training and design. (Meister, 1999)

Around the same time, Bush (1945) described a hypothetical electromechanical device called the MEMEX in his 1945 article 'As We, May Think'. MEMEX is a device in which an individual stores all his records, books, and communication, which is mechanized so that it may be consulted with exceeding speed and flexibility. The necessity for this device propagated from the complexity of indexing printed material which overburdened the researchers and restricted consistent connection and communication within their college. MEMEX would ensure an 'enlarged intimate supplement to one's memory. (Manovich, 2003) Bush's creation was far-sighted and consequential. The application of machines, conducive to information storage as well as retrieval was envisaged by him. In addition, he became cognizant of the value of associative indexing, together with the multimedia nature of future computer use.

During the 1950s, the computer's prospective use as a catalyst for aspects of human creativity alongside problem-solving was recognized by more people. From the period of 1960 to 1965 large numbers of proposals were outpouring about several prototype systems. As the computer's potential was proliferating, J.C.R Licklider had one of the most thought-provoking visions, for that reason he perceived the mutually stimulating interface between human and machine. In 1960, he released his exemplary work titled 'Man Machine Symbiosis' which he calculated to be the subclass of the man-machine system. His endeavour indicated what we may perhaps presently interpret, as a foundational episode of the leading-edge computing revolution. (Streeter, 2010) 'Man-Machine Symbiosis' is an anticipated occurrence that would come into existence by cooperative interaction amongst men and computers, alternatively hypothesizing that computers must become a significant symbiotic companion in numerous human activities. (Licklider, 1960)

Over the course of the previous two decades, HCI has manifested itself as the foreground for both computer science research and development and applied social and behavioural science. However, from the word go it was governed by a strong emphasis on usability and task; subsequently, research began to focus on emotion, beauty, pleasure, and experience. (Diefenbach et al., 2014) HCI became apparent as a sphere of influence on computer science in the late 1970s to early 1980s. The speed of its escalation was dynamic, occasionally rapid, and at times steady for two to three decades, along the way impressing, inspiring, and engaging experts from numerous specialty areas and accommodating diverse approaches and concepts.

The rise in personal computing was witnessed in the 1970s, which made everyone in the world a potential computer user and vividly highlighted the deficiencies of computers concerning usability for those who wanted to use computers as tools. (Carroll, 2013) This initiative of cognitive science included artificial intelligence, cognitive psychology, linguistics, philosophy of mind, and cognitive anthropology. In the present circumstances, practically every individual in advanced countries corresponds and interacts with personal computers to at least some extent. Many people make use of and benefit from such devices employed for entertainment, acquiring information, and increasing the understanding of things. It is anticipated that almost everyone who operates a personal computer does so by using GUI which is a visual way of interacting with computers or other electronic devices using icons, menus, windows used in predominance by operating systems. (Reimer, 2005) During the 1980's GUI was developed for the process of easier understanding by the users. Before GUI, there was a command prompt whereby a command was provided to the computers. Initiation of graphical interface occurred signifying ease in usage, comprehension, visualization, and advancement in the working environment. During the same time, Apple's Macintosh popularized the "messy desktop metaphor". Scattered files and folders around the display surface were displayed as icons. The cluttered desktop acted as the stimulator for emergence of graphical user interfaces. (Gentner & Nielsen, 1996) This desktop metaphor captured the creativity of designers and the public.

Around the mid-1990s, World Wide Web pages emerged, linking hypertext documents into an information system, accessible from any node on the network. (Couldry, 2012) According to the chronological narrative for the emergence of the internet, it can be observed that its origin inspired effort to construct as well as interconnect computer networks which became apparent from research and development in the United States and was followed by international collaborations, especially with researchers in the United Kingdom and France. (Cerf, 1993) The internet had a revolutionary impact on culture and commerce, which became evident in the mid-1990s. An increasingly prominent influence was witnessed due to the origination of various applications and tools which were responsible for providing support to collaborative activities, further increasing near-instant communication via emails, instant messaging, voice over Internet Protocol (VoIP) telephone calls, video calls, social networking services, and other media services. This made it possible for individuals to interact with other people through computers. Presently, the data transmitting speed over fibre optic networks has increased drastically. Internet's acquisition of the global communication landscape was mercurial in historical terms: in the year 1993 it constituted only 1% of the information flowing through two-way telecommunications networks, by 2000 this number had reached 51%, and the telecommunicated information reached more than 97% by 2007. (Hilbert & López, 2011) Subsequently, it was realized by HCI experts and professionals that search is a more fundamental paradigm than browsing for finding things in a user interface. (Carroll, 2013) As a result, several advanced technologies punched the time clock for better communication.

With the onset of the twenty-first century, computers stepped away from desktops and were observed to be omnipresent. Presently, computers have established themselves in cell phones, smart televisions, cars, homes, and public spaces. Mobile computing has evolved extensively. When arriving at a local café it is out of the ordinary to observe a laptop not linked to a hotspot static network. This is a consequence of mobile computing which enables the transmission of data, video, voice by the means of any wireless-enabled device without the need to connect to a fixed physical link. Mobile computing is all about easily manageable and portable devices including PDAs which refer to personal digital assistants, offered by mobile phones, laptops, tablet PCs, e-readers, and handheld gaming devices. With the advancement in technology, people are compelled to work with computers and the internet. Presently, most laptops and personal automated devices have wireless connectivity cards and bluetooth interfaces incorporated into them for trouble-free mobile internet access. (History of Mobile Computing, 2012)

Canvassing significant milestones achieved during the emergence of HCI, the development of QWERTY keyboards tops the list with its origination in 1873 by Christopher Sholes, this QWERTY keyboard was implemented in the first typewriter. The drive behind this creation was that Sloles wanted to organize keys to avoid jams. (Weller, 1918) Furthermore, a breakthrough was achieved in the year 1945, when the development of the first programmable general-purpose electronic digital computer titled 'ENIAC' (Electronic Numerical Integrator & Computer) took place. John Mauchly & his colleagues participated in this government-funded project, work on which began in the year 1943. (Weik, 1961) In the year 1967, Ralph Bauereckert created the first joystick to be used in gaming and was utilized in shooters simulation games. (Edwards, 2017) By 1968, the first virtual reality head-mounted display system called "Sword of Damocles" was created by the accomplished computer scientist Ivan Sutherland. (Krevelen, 2007) In 1982, 3D printing technology was created by Dr. Hideo Kodama to develop a rapid prototyping technique that was suitable for the production of aesthetic or functional prototypes. (Hahn, 2018) In 1998 Steve Mann, also labeled as 'Father of Wearable Headband, created the first Linux-powered smart watch. (Pothitos, 2016) In 2006, through natural user interface and gesture recognition, Nintendo Wii came to life to track a user's motions and translate them into instructions or responses. In 2011, a Google voice search app was developed, allowing users to interact with their phones by making Google queries.

The Emergence of Human-Computer Interaction: Indian Perspective

Globally HCI emerged as an interdisciplinary field; however, HCI's emergence in India is attributable to the active participation of industrial designers and visual communication designers present at Industrial Design Centre (IIT Bombay) and National Institute of Design (Ahmadabad) in 1985. Designers are considered the primary contributors with regards to the ergonomics of interface design, which has now manifested itself as an independent sphere of study, identified as 'Interaction Design'. Several terminologies are utilized concerning Interaction Design in India, which includes Human-Computer Interaction (HCI), User Interface Design (UI), or User Experience (UX) which are splinter groups belonging to a comprehensive concept otherwise known as 'Usability'. (Nielsen, 1993) Meanwhile, certain specialists in India have adopted the term HCI, other individuals compare and contrast 'Interface Design' and 'Interaction Design'. Some experts suppose that 'interaction' is independent of 'usability' albeit some press on dubbing it as 'Cognitive Ergonomics'. Before the emergence of computer science discipline within the Indian education system, a considerable number of design schools demonstrated an inextricable linkage with User-Centered Design (UCD) which forms the substratum of HCI, Usability Engineering (UE), User Experience (UX), and Interaction Design (ID).

Granting the fact that design educational facilities had thus far acquainted its curricula with the principles of HCI, HCI has not yet coalesced into an independent branch of learning in India. From 1985 to 1990 educational programs, namely 'Control Panel Design' & 'Ergonomics of Electronic Equipments' provided at the Indian Institute of Science (IISc), Bangalore, were meant to design interfaces for medical, laboratory industrial as well as electronic tools. Within these specializations, the fundamentals of design employed for the interface of electronic products and physical instruments developed from Ergonomics and were introduced within the framework of industrial or product design programs. Subsequently, it can be said with certainty that design schools in India have laid the foundation, especially for trained and skilled human capital, for this particular domain.

Although it appears that HCI pays exclusive heed to technological devices, in practical terms, it has moved beyond the usability concerns of information technology and computing. In the present circumstances, it voices concern over more extensive issues regarding ethics alongside the social implications of mechanized digital instruments. The 'computer' component of HCI is generally preferential for computer science researchers, as opposed to the 'human component of HCI. On the contrary, scholars in design schools concentrate greatly on the 'human' component of HCI. However, these two specializations have a vested interest in the 'interaction' component of HCI. At the same time, it can be ascertained that Indian design schools are ahead of their computer science counterparts in HCI/ID/UE/UX. (Yammiyavar, 2010) But at this point within India, it can be observed that HCI is greatly focused on IT and computer science institutions as they have realized the potential of HCI as a specialization.

Proceedings of the 10th Indian conference on HCI which took place in 2019 demonstrate interest being diverted, wherein research work on 'Comparison of verbalized navigation by visually impaired users with navigation based on an instruction from Google maps' was conducted. (Srikrishnan & Joshi, 2019) Another research article talks about the usage of directional gestures on the keyboard for the cursor. (Parsoya & Rajamanickam, 2019)

India's first research laboratory for ID was founded in the year 2003, at the Indian Institute of Technology, Guwahati (Assam), named 'Usability Engineering and Human-Computer Interaction Design Laboratory'. This exclusive facility was established to focus on ID, Usability Engineering, User Experience Design, software prototyping, and electronic hardware. From this moment forward, IIT-G has enrolled numerous students for its B.Des course in ID, leading on to grant Ph.D. as well in this specialization. In 2006, Industrial Design Centre, IIT Bombay, and NID, Ahmedabad expanded their core curriculum and provided ID postgraduate training courses.

By orchestrating national and international conferences in India, educational establishments have joined hands to facilitate advancements in the research arena for the benefit of the public, endorsing proceedings that require paying considerable attention to the HCI domain. In the year 2002, the first-ever HCI seminar took place at IISc, Bangalore, which European academicians attended. In 2004, a conference on system usability, HCI, and user-centered design was arranged in Bangalore. (Yammiyavar, 2005) The conference was conducted through the agency of organizations including, Indo-European Systems Usability Partnership, alongside Computer Society of India, International Federation for Information Processing, and the British Computer Society. Human Work Interaction Design (HWID) was an international conference that took place in 2009 in Pune that helped cement research work in ID in India. This conference was administered by Copenhagen Business School, Aarhus University Denmark alongside the Indian Institute of Technology Guwahati (Clemmensen et al., 2010) Succession of India HCI conferences have been organized since 2005, headed by IIT Bombay. IIT Guwahati and IIT Indore hosted the most recent one in the year 2020.

Indian IT industries reacted promptly toward the identification of productive specialist's assemblage, multiplying in the HCI sphere. This has assisted in offering supplementary expertise and services to global IT firms as. Currently, usability is considered to be of utmost importance for any product deliverable to the user, and IT industries are aware of that fact. Top organizations work with usability testing companies and consultancies to evaluate their products.

CONCLUSION

Cassell (2016) director emeriti of Human-Computer Interaction Institute, Pittsburgh, Pennsylvania has mentioned that, "Presently computers are an all-encompassing part of human life, as their implicit presence can be encountered in almost everything. Even though we picturise computers as rectangular devices found in our workspace or study space, or nowadays in the form of gadgets which can easily fit into our pockets, however the mechanism of computers can also be traced in our cars, refrigerator, thermostats. These devices can no longer be considered as objects, as they are gradually permeating to virtually every other material we have come to know."

HCI will also be accountable for defining the future, considering it is progressively embedded in our daily lives more than ever before. It has become such an essential part of modern life that some struggle to imagine living without our devices. And when we do, we sometimes experience a low-level dread or anxiety that researchers have called 'nomophobia'. A combination of the words 'no', 'mobile', and 'phobia', nomophobia is a modern phenomenon highlighting a very new type of relationship between humans and machines. (Murphy, 2019).

Widely increasing application of HCI can be observed in the traffic control system of India wherein, it has become possible for police personnel to detect violation of traffic rules with the aid of technologies including Light Detection and Ranging guns (LIDAR), speed detection displays, and variable message signs (using LED boards). This has further led to cities being dubbed as 'Smart Cities'. The recent implementation of FASTag on toll plazas is also an excellent example of human interaction with technology. FASTag has plentiful benefits, including ease of payment, no stoppage of vehicles which further leads to lower fuel waste, SMS alerts for transactions, cash back incentives, to name just a few.

CONFLICT OF INTEREST

The author declares no conflict of interest.

REFERENCES

1. Baecker, R. (1995). Readings in Human-Computer Interaction (1st ed.). Morgan Kaufmann.
2. Bieller, E. (2021, August 6). What's The Future Of Human-Computer Interaction (HCI)? Career Foundry.https://careerfoundry.com/en/blog/ui-design/the-future-of-human-computer-interaction-whats-next/
3. Bush, V. (1945, July). As We May Think. The Atlantic. https://www.theatlantic.com/magazine/archive/1945/07/as-we-may-think/303881/
4. Carroll, J. M. (2013). Human Computer Interaction - brief intro. In Encyclopedia of Human Computer Interaction (2nd ed.). The Interaction Design Foundation. https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed
5. Cassell, J. (2016, December 05). By 2030, this is what computers will be able to do. World Economic Forum. https://www.weforum.org/agenda/2016/12/by-2030-this-is-what-computers-will-do/
6. Cerf, V. (1993). How the Internet Came to Be. The Online User's Encyclopedia," by Bernard Aboba. https://web.archive.org/web/20170926042220/http://elk.informatik.hs-augsburg.de/tmp/cdrom-oss/CerfHowInternetCame2B.html
7. Clemmensen, T., Katre, D., Yammiyavar, P., & Ørngreen, R. (Eds.). (2010). Human Work Interaction Design: Usability in Social, Cultural and Organizational Contexts (Vol. 316). Springer Science+Business Media.
8. Couldry, N. (2012). Media, Society, World: Social Theory and Digital Media Practice. Cambridge: Polity Press. https://www.wiley.com/enus/Media%2C+Society%2C+World%3A+Social+Theory+and+Digital+Media+Practice-p-9780745639208
9. Diefenbach, S., Kolb, N., & Hassenzahl, M. (2014). The 'hedonic' in human-computer interaction: history, contributions, and future research directions. Proceedings of the 2014 conference on Designing interactive systems, 305–314. 10.1145/2598510.2598549
10. Edwards, B. (2017, May 15). Video Games Turn Forty (2007). Vintage Computing & Gaming. http://www.vintagecomputing.com/index.php/archives/1107/video-games-turn-forty
11. Gentner, D., & Nielsen, J. (1996, August). The Anti-Mac interface. Communications of the ACM, 39(8), 70-82. https://doi.org/10.1145/232014.232032
12. Hahn, B. (2018, Feb 6). History of 3D Printing. Me3D. https://me3d.com.au/2018/history-of-3d-printing/
13. Hewett, T. T., Baecker, R., Card, S., Carey, T., Gasen, J., Mantei, M., Perlman, G., Strong, G., & Verplank, W. (1992). ACM SIGCHI Curricula for Human-Computer Interaction. New York : Association for Computing Machinery. 10.1145/2594128
14. Hilbert, M., & López, P. (2011, April 1). The World's Technological Capacity to Store, Communicate, and Compute Information. Science, 332(6025), 60-65. 0.1126/science.1200970
15. History of mobile computing. (2012, October 10). Mobile Computing. https://mobilecomputingproject.wordpress.com/2012/10/10/history-of-mobile-computing/
16. Holden, K. L., Ezer, N., & Vos, G. A. (2013). Evidence Report: Risk of Inadequate Human-Computer Interaction.
17. Issa, T., & Isaias, P. (2015). Sustainable Design: HCI, usability and environmental concerns. Springer, London. 10.1007/978-1-4471-6753-2
18. Kim, G. J. (2015). Human–Computer Interaction Fundamentals and Practice (1st ed.). Auerbach Publications. https://doi.org/10.1201/b18071
19. Krevelen, D.W.F. v. (2007, April 18). Augmented Reality: Technologies, Applications, and Limitations. Vrije Universiteit Amsterdam, Department of Computer Science De Boelelaan 1081a, 1081 HV Amsterdam, The Netherlands.
20. Lee, J. Y., Kim, J. Y., You, S. J., Kim, Y. S., Koo, H. Y., Kim, J. H., Kim, S., Park, J. H., Han, J. S., Kil, S., Kim, H., Yang, Y. S., & Lee, K. M. (2019). Development and Usability of a Life-Logging Behavior Monitoring Application for Obese Patients. Journal of Obesity and Metabolic Syndrome, 28(3), 194-202. 10.7570/jomes.2019.28.3.194
21. Levy, S. (2018, March 29). graphical user interface. Encyclopedia Britannica. https://www.britannica.com/technology/graphical-user-interface
22. Licklider, C. J. (1960). Man-Computer Symbiosis. IRE Transactions on Human Factors in Electronics, HFE-1, 4-11. https://groups.csail.mit.edu/medg/people/psz/Licklider.html
23. MacKenzie, S. I. (2012). Human-Computer Interaction: An Empirical Research Perspective. Netherlands: Elsevier Science. https://www.google.co.in/books/edition/Human_Computer_Interaction/k0kBgyCaokAC?hl=en&gbpv=0
24. Manovich, L. (2003). New media from Borges to HTML. The new media reader, 1(2), 13-25.
25. Meister, D. (1999). The History of Human Factors and Ergonomics (1st ed.). CRC Press. https://doi.org/10.1201/9781315276069
26. Murphy, A. (2019, June 12). 7 Reasons to Study Human-Computer Interaction. Keystone Academic courses. https://www.academiccourses.com/article/seven-reasons-to-study-human-computer-interaction/
27. Myers, B., Holland, J., Cruz, I., Bryson, S., Bulterman, D., Catarci, T., Citrin, W., Glinert, E., Grudin, J., & Ioannidis, Y. (1996, Dec). Strategic directions in human-computer interaction. ACM Computing Surveys, 28(4), 794-809. 10.1145/242223.246855
28. Myers, B. A., & Rosson, M. B. (1992, June). Survey on user interface programming. CHI '92: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 195–202. 10.1145/142750.142789
29. Nielsen, J. (1993). Usability Engineering. Netherlands: Academic Press. https://www.google.co.in/books/edition/Usability_Engineering/95As2OF67f0C?hl=en&gbpv=1&dq=Jakob+Nielsen.+(1993).+Usability+Engineering.+Netherlands:+Academic+Press.&pg=PR9&printsec=frontcover
30. Nielsen, J. (2012, January 3). Usability 101: Introduction to Usability. Nielsen Norman Group. https://www.nngroup.com/articles/usability-101-introduction-to-usability/
31. Nielsen, J., & Mack, R. L. (1994). Usability Inspection Methods (J. Nielsen, Ed.). John Wiley & Sons.
32. Nielsen, J., & Molich, R. (1990, March 1). Heuristic evaluation of user interfaces. CHI '90: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 249–256. 10.1145/97243.97281
33. Parsoya, A., & Rajamanickam, V. (2019, November). KeySlide: using directional gestures on keyboard for cursor positioning. Proceedings of the 10th Indian Conference on Human-Computer Interaction. 0.1145/3364183.3364186
34. Poppe, R., Rienks, R., & Dijk, B. v. (2007). Evaluating the Future of HCI: Challenges for the Evaluation of Emerging Applications. In Artificial Intelligence for Human Computing (Vol. 4451, pp. 234-250). Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-540-72348-6_12
35. Pothitos, A. (2016, Oct 4). The History of the: Smartwatch. Mobile Industry Review. https://www.mobileindustryreview.com/2016/10/33860.html
36. Reimer, J. (2005, 5 5). A History of the GUI. Arstechnica. https://arstechnica.com/features/2005/05/gui/
37. Srikrishnan, A., & Joshi, A. (2019, November 1). Comparison of verbalized navigation by visually impaired users with navigation based on instructions from Google maps. IndiaHCI '19: Proceedings of the 10th Indian Conference on Human-Computer Interaction, 2019, 1-6. https://doi.org/10.1145/3364183.3364193
38. Streeter, T. (2010). The Net Effect Romanticism, Capitalism, and the Internet. NYU Press.
39. Weik, M. H. (1961). The ENIAC Story. Wayback Machine. https://web.archive.org/web/20110814181522/http://ftp.arl.mil/~mike/comphist/eniac-story.html
40. Weller, C. E. (1918). The early history of the typewriter. La Porte, Ind., Chase & Shepard, printers.
41. Wong, E. (2020, July). Heuristic Evaluation: How to Conduct a Heuristic Evaluation. Interaction Design Foundation.https://www.interaction-design.org/literature/article/heuristic-evaluation-how-to-conduct-a-heuristic-evaluation

42. Yammiyavar, P. (2005, September). Incorporating HCI in the curriculum – a case study. CSI Communications, 29(3).
43. Yammiyavar, P. (2010). Status of HCI and Usability Research in Indian Educational Institutions. Human Work Interaction Design: Usability in Social, Cultural and Organizational Contexts, 316. https://doi.org/10.1007/978-3-642-11762-6_2