



HUMAN COMPUTER INTERACTION BASED ON NATURAL COMPUTING TECHNIQUE

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CHAPTER 01: INTRODUCTION The human-computer interaction is the way in which people interact with computers and computer systems. The human-computer interaction has been a topic of research for many years, but it has seen increased interest recently due to the rise of digital assistants. The idea that humans and computers should interact is not new. However, the recent developments in technology have brought about more opportunities for human-computer interaction. Recent advancements in artificial intelligence and machine learning have opened up exciting possibilities for AI to facilitate interactions between humans and machines. For example, some AI software can help users navigate complicated websites by offering visual cues on what to do next, such as when you are looking for a specific item on Amazon or Netflix. According to author Steven Levy, "the big question is whether humans will continue to be involved Human Computer Interaction is a field of study that focuses on how humans interact with computers. It is a broad area of research that includes topics such as user interface design, human-computer interaction techniques, and human-computer interaction theory. Human Computer Interaction (HCI) is an interdisciplinary field that studies the ways in which people interact with computers and other devices in their daily lives. In this article, we're going to take a look at the different types of HCI tools available for developers and designers to use. 1 1Card, Stuart K.; Thomas P. Moran; Allen Newell (July 1980). "The keystroke-level model for user performance time with interactive systems". *Communications of the ACM*. 23 (7): 396–410. doi:10.1145/358886.358895. S2CID 5918086 1 Human computer interaction is a term that refers to the study of how people interact with computers and other technologies. It also includes the study of how humans and computers can work together to create new products and services. Human Computer Interaction is a broad topic that encompasses many different disciplines including design, engineering, psychology, sociology, human-computer interaction (HCI), cognitive science, and information science. The future of Human Computer Interaction is bright as it will be used in various industries such as healthcare, education, finance, manufacturing and more. Human-computer interaction is the study of how people interact with computers. It is an important topic in computer science and it also has implications for other fields such as psychology, sociology, cognitive science, and anthropology. The goal of human-computer interaction is to make the interaction between humans and computers as natural as possible. It includes a variety of techniques that help humans use computers more effectively. These include things like using a mouse or keyboard to navigate a graphical user interface (GUI), learning how to use software programs such as word processors or spreadsheets, learning how to search for information on the Internet.2 The term human computer interaction is used to describe the ways in which people use computers and other digital devices. The most common example is the use of a computer keyboard or mouse. The human-computer interaction (HCI) is a field of study that deals with the design and use of computer technology in relation to human behavior. HCI is a new and emerging field that has been around for less than 50 years. It has been an important part of our lives since then. It has evolved from being an 2Carlisle, James H. (June 1976). "Evaluating the impact of office automation on top

management communication". Proceedings of the June 7-10, 1976, national computer conference and exposition on - AFIPS '76. Proceedings of the June 7-10, 1976, National Computer Conference and Exposition. pp. 611-616. doi:10.1145/1499799.1499885. S2CID 18471644. Use of 'human-computer interaction' appears in references 2 academic discipline to becoming a key component in how we interact with computers today. The evolution of HCI can be attributed to many factors, such as the evolution of computing technology, the rise in mobile computing, and more recently, the advent and rapid growth of social media platforms like Facebook and Twitter. Human-Computer Interaction is the process of humans interacting with computers in a structured way. It is also the study of how people interact with technology and how these interactions are influenced by design and technology. Human-Computer Interaction has been around since the 1950s when it was first used to control computers remotely. Now, it is a widely used field that involves designing specific interfaces for different platforms such as mobile devices, desktop computers, and gaming consoles.³ The goal of Human Computer Interaction is to create a system that fulfills the needs of users by providing them with an interface that's easy to use. Human-computer interaction is the study of how people interact with computers and computer systems. Human-computer interaction is a broad field that spans many different disciplines, including human factors engineering, ubiquitous computing, human-computer interaction research, and computer graphics. Human-computer interaction can be seen as a branch of ergonomics or human factors engineering. This can be traced back to the early 1800s when Hermann von Helmholtz conducted experiments on his own body to understand how it works in relation to other objects in space. ³ Suchman, Lucy (1987). *Plans and Situated Action. The Problem of Human-Machine Communication*. New York, Cambridge: Cambridge University Press. ISBN 9780521337397. Retrieved 7 March 2015. ³ Human Computer Interaction (HCI) is the study of how people interact with computers and other devices. It is a field that deals with the design, evaluation and implementation of interactive systems to meet human needs. HCI is a broad field that encompasses research in many different domains such as human-computer interaction, social computing, computer-supported cooperative work, usability engineering and ubiquitous computing. Many companies are now turning to HCI professionals to help them create better user experiences for their products. Human-computer interaction is the study of the ways in which humans use computers and how computers can be made to support human needs. It is a field that has its roots in computer science, but it also draws on fields such as psychology and sociology.⁴ The HCI field has grown significantly over the past few years as more and more people are using computers at work or at home. This growth has led to a need for professionals who are experts in this field. These professionals use their expertise to design interfaces, develop software, conduct user research, and create content for websites and apps. Human-computer interaction is an area of study that deals with the design, use and effects of human-computer interactions. It is a field that explores how humans interact with computers and other devices. OBJECTIVE: The objective of this study is to understand about the Human Computer Interactions, and how it is beneficial for the upcoming generation and how it can be technologically revolutionary. ⁴Dourish, Paul (2001). *Where the Action Is: The Foundations of Embodied Interaction*. Cambridge, MA: MIT Press. ISBN 9780262541787. ⁴ CHAPTER 02 LITERATURE REVIEW Human Computer Interaction (HCI) HCI is an interdisciplinary field that encompasses a variety of topics such as ergonomics, human factors, computer graphics, user interface design, computer programming and human-computer interaction. It can also be referred to as "human machine interaction." Human-Computer Interaction is the study of how people interact with computers, and how computer systems can be designed to support human interaction. The purpose of this study is to understand what makes humans and computers different from each other, as well as the similarities. These days, we are surrounded by technology that can be controlled with our fingertips. We have smartphones, tablets, laptops and more. As technology becomes more advanced and ubiquitous in our lives, it is important to remember that there are two sides - human and computer - in a given interaction.⁵ Human Computer Interaction is the study of how humans interact with computers and how computers can be made to better serve humans. One of the most important parts of HCI is the design process which has four phases: research, ideation, prototyping, and evaluation. Human Computer Interaction is an important part of any digital product or service because it can help make digital products more usable for people.⁶ ⁵Hewett; Baecker; Card; Carey; Gasen; Mantei; Perlman; Strong; Verplank. "ACM SIGCHI Curricula for Human-Computer Interaction". ACM SIGCHI. Archived from the original on 17 August 2014. Retrieved 15 July 2014. ⁶ en:Multimodality, oldid 876504380 ⁵ Human computer interaction is a field that deals with the design and use of interactive computing devices. It is important to understand how people interact

with computers as they are becoming more and more integrated into our daily lives. Human computer interaction is a complex topic that has been explored in many ways by different people. One of the most important aspects of this field is how we can design interfaces that are intuitive and user-friendly for humans to use, while not being too complicated for computers to process. Human Computer Interaction is the study of how humans interact with computers and other digital systems. It is considered as a subfield of Human-Computer Interaction which focuses on the use of technology in human-to-human interaction. Human Computer Interaction is an integral part of many industries like healthcare, education, public safety and more. There are many different types of HCI research that are being conducted today. Some examples include usability testing, user experience design, and human computer interaction design.⁷ There are many ways to interact with a computer, such as through voice and touch. The human computer interaction can be broken down into three levels: physical, social, and cognitive. Human-computer interaction is a complex topic that touches on many different fields. It can be seen as an important part of our lives because it helps us find solutions to problems that we face every day. Human-computer interaction is the study of how people interact with computers and how this interaction affects the design of computer systems. Human-computer interactions are diverse, from using a computer to play games to interacting with a robot in a factory. The major goal is to create an interface that makes it easy for humans to interact with machines. ⁷ Ergoweb. "What is Cognitive Ergonomics?". Ergoweb.com. Archived from the original on September 28, 2011. Retrieved August 29, 2011. ⁶ The human-computer interactions have been increasing in recent years due to the development of new technologies such as voice recognition, speech synthesis, and gesture recognition. Human-Computer Interaction (HCI) is the study of how humans interact with computers and how computers can be made to better understand human behavior. HCI also refers to the design, engineering, and research of computer systems that have an effect on human behavior. The design of a system is often accomplished through prototyping, which is a systematic process for creating or revising a product idea or service concept through the creation of working models. Prototyping allows designers to explore the problem space and assess their ideas in a low-risk environment. Prototypes are often used as part of the iterative design process in which changes are made to improve a product over time. Humans and computers are interacting with each other in many different ways. The purpose of this paper is to explore the different types of interactions, the technologies that facilitate these interactions, and the benefits that these technologies provide.⁸ Human-Computer Interaction (HCI) is a field that has been around for decades. It is a study of how people interact with computers and how technology can be used to support human interaction. HCI encompasses many areas such as human-computer design, human-computer interaction techniques, computer graphics, virtual reality, wearable computing and ubiquitous computing. HCI has been expanding its scope over the years as new technologies have been created to support human interaction with computers in new ways. These include touch screens, voice recognition software and augmented reality platforms. Human Computer Interaction is the study of how people interact with computers, software, and technology. It includes studying the design of interfaces, devices, and applications. ⁸ "NRC: Backgrounder on the Three Mile Island Accident". Nrc.gov. Retrieved August 29, 2011. ⁷ Human-computer interaction is a field that has been around for many years. It has evolved to include the study of human-computer interaction design (HCI) in recent years. This field is not just limited to computer science or information technology but also includes social sciences such as psychology and sociology as well as business management. There are two main types of human-computer interaction: 1) User Interfaces (UI) which are the user's point of view on how they interact with a device or application 2) HCI which is an interdisciplinary field that studies how humans use computers and other technologies Human-Computer Interaction is the interaction of humans with computers. This interaction can be in a variety of forms such as using software, mobile apps, or websites.⁹ The introduction briefly describes the section topic and keywords, then provides a brief overview on what Human-Computer Interaction means. Human-Computer Interaction is the study of how people interact with computers and how they can be made more intuitive, efficient, and useful. HCI is a field that has been around for decades. In the last few years, it has seen a lot of developments thanks to technological advancements in AI and machine learning. Humans and computers have been interacting with each other for a long time. However, the way they interact has changed over time. ⁹ rudin, Jonathan (1992). "Utility and usability: research issues and development contexts". *Interacting with Computers*. 4 (2): 209–217. doi:10.1016/0953-5438(92)90005-z. Chalmers, Matthew; Galani, Areti (2004) ⁸ The use of human computer interaction has greatly increased in recent years. It is now used in various fields such as healthcare, education, and

manufacturing. The use of technology has helped transform the way we interact with each other. Humans have become more collaborative and computer systems are able to learn from humans by watching their interactions with one another. Human-computer interaction is the study of how humans and computers can interact with each other. It is a field that has been studied since the 1950s. In the past, computers were used to automate tasks that were either too tedious or too complicated for humans to complete. Computers could solve problems in ways that were not possible for people. However, with advances in technology and growth of AI, human-computer interaction is now more about collaboration than automation. Human-computer interaction is a field of study that focuses on how people use computing devices and technologies. It is an interdisciplinary field that draws from fields such as psychology, sociology, computer science, architecture, and design.¹⁰ The main focus of human-computer interaction is to create a user-friendly experience for the end user. It can be achieved by understanding the user's goals, needs, and motivations in order to design a system that satisfies these needs in an appropriate manner. Human-Computer Interaction has been a topic of interest in recent years due to its relevance for many industries such as healthcare and education. The Human Computer Interaction (HCI) is the study of how people interact with computers and other devices. It is a multidisciplinary field that encompasses computer science, human factors, cognitive science, and industrial engineering.¹⁰ Chalmers, Matthew; Galani, Areti (2004). *Seamful interweaving: heterogeneity in the theory and design of interactive systems* (PDF). *Proceedings of the 5th Conference on Designing Interactive Systems: Processes, Practices, Methods, and Techniques*. pp. 243–252. doi:10.1145/1013115.1013149. ISBN 978-1581137873. S2CID 12500442. 9 HCI has been around for a long time but it has seen a recent surge in popularity due to the advancements in technology. This is mainly because of the increased use of mobile devices and wearable technologies. Human-Computer Interaction is a broad term that is used to describe the ways in which humans and computers interact. It includes all of the different ways for people to use computers, phones, tablets, and other devices to accomplish their goals. Human-Computer Interaction has been evolving rapidly over the past few decades with the advent of new technologies such as computer vision, speech recognition, and natural language processing. Having an understanding of HCI is necessary for any professional who deals with computers on a regular basis. 10 CHAPTER 03 DISCUSSION, ANALYSIS AND FINDINGS Human-Computer Interaction is a very broad area that describes the way humans interact with computers. It includes how to design, develop and implement software, systems and devices that are easy to use and understand by humans. Human Computer Interaction is the study of how people interact with computers, software and devices. Humans have been interacting with computers for a long time, but it has been advancing at a rapid pace in recent years. This is because of the advancement in technology and the widespread use of smartphones. We can now use virtual assistants like Siri or Alexa to perform tasks such as book an event or make a reservation. The AI-powered virtual assistants are also known as Conversational Agents and provide more natural interaction between humans and machines than traditional human-computer interfaces.¹¹ The term "conversational agent" was first coined by IBM's former VP of research, Michael Mahoney in his blog post "Conversational Agents: A New Era for Interaction" in 2011. He defined it as "an artificially intelligent Human-Computer Interaction (HCI) is the study of people interacting with computers and digital devices. The goal of HCI is to design a system that helps users to interact with computers and digital devices in a more natural way. HCI has been around for decades, but it was not until recently that it became a mainstream topic. This is because the use of technology has increased drastically in recent years, making it difficult for people to adapt to new technology. The human-computer interaction field has also been growing rapidly as both AI and robotics have progressed.¹² 11 Barkhuus, Louise; Polichar, Valerie E. (2011). "Empowerment through seamfulness: smart phones in everyday life". *Personal and Ubiquitous Computing*. 15 (6): 629–639. doi:10.1007/s00779-010-0342-4. 12 Rogers, Yvonne (2012). "HCI Theory: Classical, Modern, and Contemporary". *Synthesis Lectures on Human-Centered Informatics*. 5 (2): 1–129. 11 Human-Computer Interaction is a term that refers to the ways in which humans use computers and how these computers are used by humans. This can be done through one or more of the following: input, output, and interaction. Human-Computer Interaction is an important part of creating digital products that are more accessible and easy to use. Human Computer Interaction (HCI) is the study of how humans interact with computers and digital devices. It's a field that includes design, usability, and cognitive psychology. HCI is an important part of the future of UI/UX design as it helps to make sure a product or service is usable by all people. The study of how humans interact with computers and digital devices such as mobile phones, tablets, desktops, etc.¹³ It includes design, usability testing, cognitive psychology

HCI is an important part of the future of UI/UX design as it helps to make sure a product or service is usable by Human-computer interaction is a field that is constantly evolving. It can be defined as the study or design of how people interact with computers and other devices. HCI research has been applied to many areas, including digital games, health care systems, robotic systems and more. Human computer interaction is the study of how humans use computers and how computer systems can be designed to support human activity. The core idea behind the human computer interaction is that humans and computers should work together in a way that makes both parties feel comfortable. This helps to improve the user experience and minimize wasted time. 13Sengers, Phoebe; Boehner, Kirsten; David, Shay; Joseph, Kaye (2005). Reflective Design. CC '05 Proceedings of the 4th Decennial Conference on Critical Computing: Between Sense and Sensibility. 5. pp. 49–58. doi:10.1145/1094562.1094569. ISBN 978-1595932037. S2CID 9029682. 12 One such way in which companies are using HCI is by using it as part of their design process. This helps them to make sure that their products are efficient and effective for their users. Human-computer interaction (HCI) is the study of the interactions between humans and computers, which takes place in various contexts, ranging from personal to social. The HCI research has been applied to a wide range of areas including humancomputer interaction, computer graphics, human-robot interaction, computer security, and many more.14 HCI is also related to interface design. This encompasses not only hardware design but also software design and both user interface design and user experience design. HCI focuses on the design, evaluation, implementation, and evaluation of interactive computing systems that can be used by humans to accomplish specific tasks. HCI is a relatively new field that has been around since the late 1960s. The term was first coined in 1968 by JefRaskin while he was working at MIT's Project MAC. This type of interaction is essential for a lot of tasks that people would need to accomplish. It covers the design and research of interactive technologies, such as computer systems and software, and how they affect people. Human Computer Interaction is an important subject in both the design world and in business. It is a field that has been studied for decades now, but it continues to evolve at a rapid pace with new technologies being introduced every day. One of the most popular topics in HCI is interaction design - which deals with designing human-computer interactions from a usability perspective. 14Green, Paul (2008). Iterative Design. Lecture presented in Industrial and Operations Engineering 436 (Human Factors in Computer Systems, University of Michigan, Ann Arbor, MI, February 4, 2008. 13 It is a field that deals with the design, development, and evaluation of interactive computing systems that are intended for human users. 15 It's important to note that HCI is not just about technology. It also includes social and cultural aspects, such as how people interact with technology in their everyday lives. Humans are always interacting with computers in one way or another. We use them for personal and professional purposes. The computer is the ultimate tool that provides us with information, entertainment, and solutions. The human-computer interaction is a topic that has been studied extensively since the 1950s when Alan Turing proposed what he called the Turing Test in his famous paper "Computing Machinery and Intelligence." The human-computer interaction is a field of study that has been around for over 50 years. It deals with the design and use of computers in human environments. The HCI industry is becoming increasingly popular as more people are using computers to perform tasks such as working, studying, and playing games. Human Computer Interaction is the study of humans and computers interacting with each other. It is the process by which people interact with a computer system in order to accomplish a task or achieve an outcome. The most common type of Human Computer Interaction is the use of a computer system to control an external device. For example, if you wanted to use your computer to control your oven, you would need to install some software that allows your computer to communicate with your oven. Human Computer Interaction is a field that deals with man-machine interactions. It is about designing and building systems that help people to interact with computers in ways that are comfortable and efficient for them. 15Kaptelinin, Victor (2012): Activity Theory. In: Soegaard, Mads and Dam, RikkeFriis (eds.). "Encyclopedia of Human-Computer Interaction". The Interaction-Design.org Foundation. Available online at http://www.interaction-design.org/encyclopedia/activity_theory.html 14 The field of Human Computer Interaction is growing rapidly with the rise of new technologies such as augmented reality and virtual reality. There are many different types of HCI fields, including user interface design, human-computer interaction, human-robot interaction, computer graphics, computer vision, robotics and artificial intelligence. When it comes to creating a digital experience, the human-computer interaction is a key factor. The human-computer interaction is the way in which humans interact with computers and technology. It is important because it determines how people use and understand technology.16

Human-computer interaction includes everything from how we use websites to our interactions with digital assistants. With AI writing assistants, there are many opportunities for companies to create more engaging digital experiences for their audiences. The study of Human Computer Interaction has been around since the 1960s, but only recently has it started to gain momentum in recent years due to advancements in technology. The most popular form of HCI is usability research which focuses on how people navigate software interfaces and what they find easy or difficult when using them. Human Computer Interaction is the study of how people interact with computers and computer systems. It includes many aspects such as human-computer interaction, human factors, and ergonomics. Human Computer Interaction is a broad field that is concerned with the use of computing technology in all areas of life. HCI deals not only with computer hardware and software but also includes design, usability, cognition, social issues, and more.

16Friedman, B., Kahn Jr, P. H., Borning, A., & Kahn, P. H. (2006). Value Sensitive Design and information systems. Human-Computer Interaction and Management Information Systems: Foundations. ME Sharpe, New York, 348-372. 15 It's been observed that humans are more comfortable interacting with machines than they are with other humans. This can be attributed to a variety of reasons such as lack of empathy or understanding on either side or the idea that machines always give correct responses without any kind of bias Human-Computer Interaction is the study of how people interact with computers and computer systems. It is a field that includes the study of human-computer interaction, ergonomics, usability engineering, and human factors.17 The main goal of Human Computer Interaction is to help people use technology in a way that suits them best. This field focuses on how to design user interfaces, provide information effectively and efficiently, create effective interactions between humans and machines. This section discusses the different ways in which humans and computers interact with each other. It also talks about the different types of human-computer interaction as well as some examples of these interactions. It is a broad field that includes the design and evaluation of all aspects of humancomputer interaction, including people's attitudes and behavior, as well as the design and evaluation of computer technologies in relation to humans. This introduction will touch on how AI writing assistants are used in business, why they are important in HCI, what they can do for businesses, and some examples of companies who use them. AI writing assistants are increasingly getting popular in the workplace. Some companies use them when they need to generate content for a specific topic or niche. While digital agencies use them to generate all kinds of content for their clients. Human-Computer Interaction is a field that has evolved over the past few decades. It is now more than just about the interaction between humans and computers. 17Wickens, Christopher D., John D. Lee, Yili Liu, and Sallie E. Gordon Becker. An Introduction to Human Factors Engineering. Second ed. Upper Saddle River, NJ: Pearson Prentice Hall, 2004. 185- 193. 16 The following are some of the ways in which AI can enhance human-computer interaction: 1) AI can be used to automatically generate data from user input to make sense of it. For example, a system can scan a person's body language and facial expressions to understand their emotional state and then provide them with appropriate content based on their reactions. 2) AI can also be used for social media marketing by analyzing posts, comments, likes, shares and feedback from users. This will help marketers create better content for their audience. It is a field that deals with the design of human-computer interfaces, including how people can interact with computers and how they can be made more accessible to people with disabilities. Human-Computer Interaction research has been conducted across many fields, including psychology, sociology, anthropology, ergonomics, and information technology. HCI has helped design user interfaces for everything from personal digital assistants to intelligent cars and robots. The field is divided into two main areas: Human-Computer Interaction (HCI) and Human-Computer Interaction Design (HCID). HCI focuses on the design of interactive systems that support human activities. This includes interaction design, user interface design, human factors engineering, usability engineering, ergonomics, and interaction research. HCID focuses on how to create an interactive system that supports human activities in a way that is effective to the users. It also covers how to create software that can be used by a diverse audience in an easy way. 17 Human Computer Interaction is the study of how humans interact with computers. It is a field that studies how people interact with computers, and how to improve the human-computer interaction. In order to get the best out of a computer, it is important for users to be able to understand the interface and know what they can do with it. In order for this to happen, it is important that users are able to use natural language and have some understanding of what they are doing. The term HCI was coined by J.C.R. Licklider in 1960 to describe the study of mancomputer interaction, which included "the design of man-machine interfaces". The first use of HCI was to help people with disabilities, such as those

with motor or speech impairments. The methods used in HCI are diverse and include natural language processing, computer vision, social computing, haptics (the sense of touch), and ubiquitous computing (the idea that computers will be everywhere). The goal of human computer interaction is to make computers easier to use, more accessible, and more usable for people with disabilities.¹⁸ Human-computer interaction has been studied for decades, but it remains a challenge. One reason for this is that the field lacks concrete guidelines on what constitutes good design. The following are some examples of human-computer interaction: touchscreens, voice commands, gestures. The field is broad and diverse, as there are different types of interfaces being designed. Some examples include: mobile apps, websites, virtual reality (VR), augmented reality (AR), wearable computing devices and smart home appliances. The goal of Human-Computer Interaction is to create an interface that allows users to interact with computers in a natural way without any difficulties or confusion. ¹⁸Brown, C. Marlin. *Human-Computer Interface Design Guidelines*. Intellect Books, 1998. 2–3. ¹⁸ It deals with how people use computers, how people design and use interfaces for computers, and how humans define what it means to interact with a computer. In this course, we will explore the history of human-computer interaction from Alan Kay's perspective, the history of interface design from Xerox PARC and Apple's Lisa project to today's popular devices such as smartphones and tablets. The most common human computer interaction methods include voice commands, touch screens, eye tracking, and haptic feedback. We can use these methods to make our lives easier in the future by making our life simpler and more efficient.¹⁹ It is a multidisciplinary field that studies the design of interfaces, software, and services for humans. The HCI has been around for decades but it has only recently started to take off in the world of technology. There are many advantages that come with using HCI as an industry. For starters, it creates jobs in a field where most businesses are looking to cut costs. Additionally, it can provide benefits such as increased productivity and reduced errors. Human-Computer Interaction also offers opportunities for companies looking for new ways to engage their customers or employees through design. It can also help companies create innovative products more efficiently by designing interfaces that are easy to use and intuitive. The human-computer interaction is an important aspect of human-machine interaction. It can be defined as the process of humans communicating with computers and vice versa, and it has a wide range of applications in various fields. The key issue about human-computer interaction is that it is a two-way communication process. There are many ways in which people interact with ¹⁹Dong, Hai; Hussain, Farookh; Elizabeth, Chang (2010). "A human-centered semantic service platform for the digital ecosystems environment". *World Wide Web*. 13 (1–2): 75–103. doi:10.1007/s11280-009-0081-5. hdl:20.500.11937/29660. S2CID 10746264. ¹⁹ computers. These include using keyboards, touch screens, voice recognition and natural language processing to name a few. The most common form of human-computer interaction is through the use of keyboards and mouse to interact with computers. However, this form has limitations because it requires users to physically move their hands or eyes to interact with the computer. This causes an increase in errors by making the user unable to pay attention at all times because they are too busy. The term "human computer interaction" (HCI) refers to the study of people and computers in their natural environments. It is an interdisciplinary field that studies how people interact with computers and other devices. Human computer interaction is a new area of study that's been gaining more attention as technologies evolve. It is the study of people and computers, taking place in their natural environments, such as workplaces, homes, schools, hospitals, etc. This field has been gaining more traction due to the increasing use of technology in our daily lives and its impact on society. The focus of human computer interaction can be divided into three different types: - HCI research: The focus on studying how people interact with software or hardware - HCI design: The focus on designing tools for It includes how people use technology to communicate, learn, work, and play. Human Computer Interaction is a broad topic that encompasses many different aspects of the digital world. This includes understanding how people engage with their devices, the design of user interfaces, and the role of technology in society. ²⁰ Humans and computers have evolved to interact with each other in a more natural way. With the advancement of technology, people are able to use computers in a more intuitive way. The field is closely related to human-computer interaction and computer science, where it focuses on the design of interactive systems for humans.²⁰ The Meteoric Rise of HCI In the 1980s, as personal computers like the Apple Macintosh, IBM PC 5150, and Commodore 64 became more common in companies and households, a new field of study called human-computer interaction (HCI) emerged. For the very first time, advanced digital systems including word processing software, gaming units, and accounting aides were made accessible to the general public. As a result, the necessity to develop human-

computer interfaces that are both simple to use and efficient for novices grew in importance as computers moved from the confines of the office to the home. When HCI was first developed, it included computer science, cognitive science, and human-factors engineering as well as other fields.²¹ Krucoff, Max O.; Rahimpour, Shervin; Slutzky, Marc W.; Edgerton, V. Reggie; Turner, Dennis A. (2016-01-01). "Enhancing Nervous System Recovery through Neurobiologics, Neural Interface Training, and Neurorehabilitation". *Frontiers in Neuroscience*. 10: 584. doi:10.3389/fnins.2016.00584. PMC 5186786. PMID 28082858. Fischer, Gerhard (1 May 2000). "User Modeling in Human–Computer Interaction". *User Modeling and User-Adapted Interaction*. 11 (1–2): 65–86. doi:10.1023/A:1011145532042

HCI was immediately the focus of a flurry of scholarly inquiry. Human-Computer Interaction (HCI) was seen by many who studied and worked in HCI as a vital tool for promoting the concept that computer-user interactions should be similar to those between humans and computers. First, human-computer interaction (HCI) researchers worked on making desktop computers more user-friendly "(i.e., practitioners concentrated on how easy computers are to learn and use)". A shift away from desktop computers toward mobile devices will be brought about by advances in Internet and smartphone technology. In addition, the scope of HCI has expanded steadily: "...it no longer makes sense to treat HCI as a specialisation of computer science; HCI has grown to be wider, bigger, and more diversified than computer science itself.... Human-computer interaction (HCI) has spread from its original focus on individual and generic user behaviour to include social and organisational computing, ease of access for the aged and those with cognitive or physical impairments, and accessibility for everyone and the broadest possible range of human opportunities and experiences. Since then, it has grown into a wide range of applications from gaming to education to business to health care to emergency preparedness to community-building tools. Extending beyond simple visual interfaces, it now includes several interaction methods and devices, as well as support for a variety of modes of interaction and a wide range of upcoming technologies such as ubiquitous mobile devices and context-sensitive interactions.²² John M. Carroll, a pioneer in the area of human-computer interaction, is the originator of this quote. The UX Value of HCI and Its Related Realms HCI encompasses a wide range of disciplines, including user-centered design (UCD), user interface (UI) design, and user experience (UX) design. HCI was a predecessor of user experience design in many aspects. ²²Conference Search: hci". www.confsearch.org.²³ Despite this, there are still considerable disparities in the approaches used by HCI and UX professionals. HCI practitioners tend to be more academically oriented than their counterparts in other fields. Scientific research and empirical understandings of consumers are two areas in which they are actively engaged. UX designers, on the other hand, are nearly always engaged in the development of goods or services, such as smartphone applications and websites. Although there is a difference between HCI and UX, the practical issues for products that we as UX experts focus on have clear ties to the discoveries of HCI specialists concerning users' thoughts. UX designers may take use of a wider range of HCI research, although most of it is still geared at academic audiences. Those of us in the design profession do not have the time advantages that those in the HCI field have. We must thus go outside the limitations imposed by the business in order to get access to these more scholarly results. The finest designs for your users may be achieved by taking use of essential information. Designers may have a significant effect on the market and society by working in "collaboration" with the HCI community.²³ A Brief History of Human-Computer Interaction

²³Julie A. Jacko (Ed.). (2012). *Human–Computer Interaction Handbook (3rd Edition)*. CRC Press. ISBN 1-4398-2943-8

²⁴ Most of us associate UI design with the academic field of Human Computer Interaction (HCI). It emphasizes on an ever intricacy and ease of human-computer interaction. It's a Very New Discipline It's possible to observe that this discipline wasn't extremely significant until the mid to late 1970s. Only a few group of academics and professionals, as well as a few very committed (and expensive) enthusiasts, had access to computers in the early days of the internet. It wasn't required to concentrate on how computer users engaged with computers without a large base of users — they merely made due with whatever was available or constructed what they needed by hand.²⁴ The floodgates opened with the advent of personal computers. Using a computer to accomplish their goals didn't need a long list of hoops to go through. Even though they purchased video games, they had no intention of making their own joysticks or designing a mouse until they learned how to operate a word processor. ²⁴Andrew Sears and Julie A. Jacko (Eds.). (2007). *Human–Computer Interaction Handbook (2nd Edition)*. CRC Press. ISBN 0-8058-5870-9

²⁵ Cognitive Sciences In a fortunate turn of events, there existed a discipline ready and eager to assist the people. As advancement in the cognitive sciences (a broad and heady mix that includes fields such as linguistics, computer science, philosophy, and even anthropology) continued into

the 1970s, they were ready to assist express the systems and science taken to create ui that started working for the general public.²⁵ Engineering Cognitive engineering, or developing things that function with our thinking, is a term for this kind of design work. In the 1970s, the engineering field had also grown tremendously in order to accommodate this shift in thinking.. Engineering, for example, has already begun to reduce the complicated aircraft' user interface. It was only a matter of time before some of this work ended up in the realm of user interface design for computers.²⁶ 25Julie A. Jacko and Andrew Sears (Eds.). (2003). Human-Computer Interaction Handbook. Mahwah: Lawrence Erlbaum & Associates. ISBN 0-8058-4468-6 26Stuart K. Card, Thomas P. Moran, Allen Newell (1983): The Psychology of Human-Computer Interaction. Erlbaum, Hillsdale 1983 ISBN 0-89859-243-7 26 CHAPTER 04 Documentation It's also critical to take into account the difficulty of accurately recording these changes. In order to keep track of advancements and communicate them with other practitioners of the new profession throughout the globe, new methodical techniques have to be implemented. Re-inventing the mouse over and over again serves no purpose. According to "John Carroll, the Edward Frymoyer Chair Professor of Information Sciences and Technology at Pennsylvania State University," all these disparate fields started to realign around a common objective: making computers easy for the people. John's book on Human-Computer Interaction is available on the IxDF website in full. If you're a member of our site, you can also download a free copy of the book to your chosen e-book reader for offline reading. CHAPTER 05 Goals for computers In the field of human-computer interaction, researchers look at how people utilise and abuse computing systems, devices, and infrastructure. Increasing the usability of computer interfaces is a major goal of research in this discipline. When it comes to computer interfaces, usability has been a hotly disputed topic in the recent years. It is a major focus of human-computer interaction research to investigate the following: methods for creating new computer interfaces that are more user-friendly, easier to understand, and faster to locate. Software libraries may be used to implement interfaces, for example. 27 Methods for comparing and evaluating the usefulness and other desired features of interfaces. Studying human-computer interaction and the ramifications it has on society and culture as a whole. If the user is human or computer-based methods of identification. Human-computer interaction models and theories, such as cognitivist user models, Activity Theory, or ethnomethodological explanations of human-computer interaction. values underlying computational design, computer usage, and HCI research activity from a critical perspective. Researchers' ideas on what they want to accomplish in their work may differ. As part of their work, cognitivists in the field of human-computer interaction may aim to match computer interfaces to human mental models of their daily activities. In an attempt to match computer interfaces with current social behaviours or sociocultural norms, HCI researchers may adopt a post-cognitivist stance. Human-computer interaction (HCI) researchers focus on establishing new design techniques, testing devices, building prototypes of software and hardware systems and exploring new interaction paradigms. 28 27Ibid CHAPTER 06 Design & Principles When assessing or creating a new user interface, the following experimental design concepts are taken into account: The user(s) and the task(s) are the first things that are considered: It is decided how many users are required to complete the task(s) and who the relevant users should be "(someone who has never used the interface, and will not use the interface in the future, is most likely not a valid user)." Aside from that, a list of what the users will be doing and how frequently they will be doing it is also provided.²⁷ The interface is tested by actual people who interact with it on a regular basis. Human-computer interaction may not always be accurately portrayed in the findings, depending on how proficient the user is. The number of users, the time it takes to complete a task, and the number of mistakes committed throughout a task are all examples of quantitative measures of usability. Following the selection of the target audience, tasks, and metrics, the iterative design process proceeds as follows: Create a user-friendly interface Test Examine the data Repeat An intuitive user interface can only be designed via iteration. 29 28Ibid Methodologies Since the field's inception in the 1980s, several techniques outlining approaches for human-computer interface design have emerged. Most plan philosophies are based on a notion of how customers, originators, and specialised frameworks interact together. When designing user interfaces, early methodologies looked to subjective science to define zones (such as memory and contemplation) instead of treating clients' psychological processes as unexpected or measurable. Newer designs, in general, rely more heavily on a constant exchange of ideas and information between the end user, developers, and experts, rather than on a finalised framework that serves as a foundation for the user experience. It is used in Human-Computer Interaction (HCI) to describe and analyse how people interact with computers. The action hypothesis provides a framework for thinking about activities in this context and

sheds light on interface design from a behavior-driven approach. 'User-centered design' (UCD) is a cutting-edge, widely-practiced planning philosophy based on the premise that customers should be the primary focus of any computer system. A framework for supporting these components is developed in collaboration with clients and architects, as well as specialised specialists. Client-centered plans are often based on ethnographic studies of the contexts in which the framework will be associated with. When it comes to the training, it's like participatory design, in which customers are encouraged to take part in the design process. It's important to keep in mind the following principles while designing a user interface: resistance, ease-of-use; permeability; affordance; consistency; structure; feedback.²⁸ An innovative method that takes into consideration both the people who use the design directly and those who are influenced by the design, whether they are 30 directly or indirectly, is called of exams in VSD: theoretical, exact, and specialised comprehend and articulate characteristics as well as any potential conflicts users. In order to help characteristics, demands, and practise quantitative methods. It's possible to do specialis technology or how it's planned Display designs Artifacts created by humans variables are known as displays. Before designing a assist must be well specified learning, entertaining, etc.)" situational awareness, and comprehension in order f information generated by 29 Nass, Clifford; Fogg, B. J.; International Journal of Human called value-sensitive design (VSD). There are three of exams in VSD: theoretical, exact, and specialised. This kind of testing aims to rticulate the many aspects of the design, along with characteristics as well as any potential conflicts that may arise for the design's end help the creators better comprehend their customers' characteristics, demands, and practises, exact assessments use either subjective or quantitative methods. It's possible to do specialised research on how people utilise planned out. by humans for use in the perception and processing of system variables are known as displays. Before designing a display, the job it is meant to specified "(e.g., navigating, controlling, decision learning, entertaining, etc.)" There must be a grasp of the concepts of perceptio situational awareness, and comprehension in order for the user or operator to digest a system and show it to them.²⁹ J.; Moon, Youngme (1996). "Can computers be teammates?". *Human-Computer Studies*. 45 (6): 669–678. doi:10.1006/ijhc.1996.0073. three types d. This kind of testing aims to with their that may arise for the design's end customers' s, exact assessments use either subjective or ed research on how people utilise of system display, the job it is meant to making, There must be a grasp of the concepts of perception, or the user or operator to digest teammates?". doi:10.1006/ijhc.1996.0073. 31 Thirteen principles of display design It was Christopher Wickens and colleagues, in their book *An Introduction to Human Factors Engineering*, that came up with the 13 display design principles. Designing an effective display may take use of human perception and information processing concepts. It is possible to reduce mistakes, reduce training time, boost efficiency, and increase user happiness by using these concepts. Diverse presentations and circumstances may call for the use of various principles. Some concepts may seem to be in opposition to one another, and there is no easy way to determine which is more significant. There are a variety of ways to apply the concepts to a particular design or circumstance. It is essential to find a balance between the concepts in order to create a successful design.³⁰ Perceptual principles 1. Make your displays readable (or audible). The usability of a display is dependent on the display's readability. Operators are unable to make efficient use of a display if they cannot read the text or objects on it. Avoid making decisions based on absolutes. Take into account more than one factor when assigning values to variables (e.g., color, size, loudness). There are a plethora of scalar values associated with these sensory variables. ³⁰Ibid ³² 33 Processing from the top down. It is conceivable that signals are seen and interpreted in accordance with the expectations of the user. It may be necessary to offer additional tangible proof of the signal if it is delivered counter to the user's expectations. Benefits of redundancy. It is more probable that a signal will be appropriately comprehended if it is provided more than once. Redundancy does not always mean repetition, therefore this may be accomplished by giving the signal in several physical forms (colour and shape, voice and print, etc.). As both the colour and the location of a traffic signal are same, this serves as an excellent illustration of redundancy.³¹ 5. Use distinguishing components to avoid similarity-induced confusion. Signals that seem similar are more likely to be mistaken for one another. Signals become similar when the number of similar characteristics is greater than the number of distinct features. Compared to 92 and 93, A423B9 and A423B8 are more closely related to each other. Dissimilar elements should be emphasised, and similar ones should be deleted if they aren't absolutely necessary. Mental model principles Accessing information as cheaply as possible and reducing the time spent doing so. As soon as the user's attention is distracted, there is a time or effort cost connected with the process. In order to keep display costs down, it's

important to place frequently used sources as close together as possible on the screen. However, this should not be done at the expense of appropriate legibility. 31Supra21 33 Principle of proximity compatibility. The execution of a single job may need dividing one's attention between two sources of information. A close mental closeness is required for mental integration of these sources. The cost of accessing information should be minimised, which may be done in a variety of ways (e.g., proximity, linkage by common colors, patterns, shapes, etc.). Close display proximity, on the other hand, might be hazardous due to the extra clutter it creates. 10. The numerous resources principle. Information from many sources may be processed more quickly by the user. Instead of delivering either visual or audible information, it is possible to show them both at the same time. Memory principles Put visual information in lieu of rote memorization: all of the world's knowledge. A user shouldn't have to rely on working memory or long-term memory to store or retrieve critical information. A menu, checklist, or other display may help the user by reducing their reliance on their memory. There are situations when storing information in your brain instead of external sources might be advantageous for the user (e.g., an expert computer operator would rather use direct commands from memory than refer to a manual). There must be a balance between a user's internal knowledge and external information in order for a design to be successful.32 Predictive assisting principle 12. In most cases, proactive measures outperform reactive ones. The user's mental resources should be reduced by eliminating cognitive activities and replacing them with simpler perceptual ones. The user will be able to concentrate on the situation at hand while also considering what can happen in the future. Road signs that show the distance to a certain destination are one example of a predictive assistance. 32Ibid 34 Consistency is an important principle to remember. If new displays are created similarly, old habits may readily be transferred to facilitate the processing of new displays. Long-term memory will activate activities that are anticipated to be correct. Consistency must be maintained across all displays in a design. Factors of change It has been traditional to model computer usage as a human-computer dyad, with each party communicating only via text-based interfaces. There has been a great deal of effort put into making the interaction between a person and a computer system more representative of the multifaceted character of regular conversation. In response to D. Engelbart's comment that "if simplicity of use were the sole legitimate criteria, people would stick to tricycles and never attempt bicycles," human-computer interaction extended its emphasis beyond the interface. [25] Human-computer interaction is advancing at a breakneck pace. Developments in computer technology have an effect on human-computer interaction. Included in this group are: As the price of hardware drops, more memory and faster computers become feasible. Hardware that is small enough to fit in a pocket or purse is more easily transportable. Improving portability by cutting down on the amount of electricity needed Computational gadgets are being packaged in novel ways thanks to new display technologies. 35 New capabilities may be achieved by specialised hardware. Technology advancements in the field of networking and distributed computing More and more individuals, particularly those who are not in a technical field, are using computers.33 As input methods (such as speech, gesture, and the pen) become more innovative and less expensive, more individuals who were previously excluded from the computer revolution are being drawn into the digital age. An increase in the availability of computers for presently disadvantaged populations due to more widespread social issues HCI is predicted[26] to have the following properties by 2010: Computing and communication everywhere. High-speed local and national networks, as well as portable infrared, ultrasonic, cellular, and other technologies are projected to be used by computers in the future. Users will be able to access data and computational services wherever they roam. systems with a great degree of flexibility. There might be a plethora of functions attached to a single system. Non-technical users and non-technical users alike lack the time and resources to learn about all of the systems that are now available (e.g., through thick user manuals). Computer graphics are now widely available. By incorporating affordable graphics processors into general-purpose computers and mobile devices, computer graphics capabilities including image processing, graphics transformations, rendering and interactive animation become more widely accessible. Various media. Commercial systems may deal with pictures, audio, video, text, and prepared data in a variety of forms. User-to-user exchanges of these are possible. 33Ibid 36 There is a growing convergence of consumer electronics (e.g. stereo sets, DVD players, TVs) and computers. Cross-assimilation between the computer and printing industries is envisaged. An interaction requiring a large amount of bandwidth. In the near future, the pace at which people and machines communicate is likely to rise significantly owing to advances in speed, computer graphics, new media, and new input/output devices such as touchscreens. Virtual reality and computational video are two examples of how this might

lead to fundamentally different interfaces. Displays that are both large and thin. Huge screens and ultra-lightweight, lowpower display technology is becoming more commonplace. Portable, pen-based computer interface systems that are a world away from today's desktop workstations will be possible as a result of this. Useful resources for gathering information. Home banking, shopping, and weather forecasts for pilots are just a few examples of information services that are predicted to grow in popularity. When high-bandwidth contact and better interfaces are introduced, the proliferation rate may increase. Existing HCI Technologies There are numerous factors of human behaviour that need to be considered in HCI design. When compared to the simplicity of the interaction approach, the degree of human engagement in interacting with a computer might seem imperceptible. With regard to both the machine itself and the level of functionality/usability, current interfaces vary greatly in complexity. Because its only purpose is to heat water, it would not be cost-effective for an electrical kettle to have an interface more complex than a thermostatic on and off switch. Although a basic website may be restricted in functionality, it must nevertheless be user-friendly to attract and retain consumers. 37 A user's interaction with a machine should be given careful consideration while developing an HCI. User activity may be broken down into three categories: physical [5], cognitive [6], and emotive [7].]. The mechanics of human-computer interaction are determined by the physical aspect, whereas the cognitive side is concerned with how users can comprehend and engage with the system. The emotional element is a relatively recent concern, and it aims to not only make the interaction enjoyable for the user, but also to effect the user in a manner that encourages them to continue using the machine by altering their attitudes and feelings [1].34 To explain how several ways of interaction may be merged (Multi-Modal Engagement) and how each mode of interaction can be enhanced in performance (Intelligent Interaction) to give a better and simpler interface for the user, this study focuses on the physical component of interaction. Existing HCI physical technologies may mostly be classified according to the device's intended human sense. Basically, these technologies depend on three human senses: vision, hearing, and touch [1]. Switch-based or pointing devices are the most prevalent types of visual input devices [8] [9]. Devices with switches and buttons, such as a keyboard, are known as switch-based devices [10]. Mouse, joystick, touch screen panel, graphic tablet and trackball are examples of pointing devices [11]. Switches and pointing capabilities are both found on joysticks. [3] The output devices might be any kind of visual display or printing device. Auditory gadgets are often more advanced and need voice recognition [12]. In order to make these gadgets easier to use, they are more complicated to create. [13]. However, creating gadgets that produce sound is far simpler. Machines now generate a wide range of output signals, including non-speech [14] and speech signals. Examples include the beeps, alerts, and turn-by turn navigation orders of a GPS. 34Nass, Clifford; Moon, Youngme (2000). "Machines and mindlessness: Social responses to computers". *Journal of Social Issues*. 56 (1): 81–103. doi:10.1111/0022-4537.00153. S2CID 15851410. 38 A haptic device is one of the most complex and expensive to develop. Skin and muscle sensations are generated by these interfaces through touch, weight and relative stiffness, according to one study. Virtual reality [17] and assistive technology for people with disabilities [18] are two common uses for haptic devices [16]. Modern approaches to human-computer interaction (HCI) are attempting to integrate more traditional ways of interaction with newer ones, such as networking and animation. Wearable gadgets [19], wireless devices [20], and virtual devices [21] are the three broad categories into which these new developments fall. Even the boundaries between these new technologies are disappearing, and they are becoming entwined. GPS navigation systems, military super-soldier enhancing devices (e.g. thermal vision, tracking other soldiers' movements using GPS, and environmental scanning), radio frequency identification (RFID) products, personal digital assistants (PDAs), and virtual tours for real estate businesses are just a few examples of these devices. Some of these innovative technologies improved upon and integrated existing modes of communication.. For example, Compaq iPAQ's Canesta keyboard is an example of a solution to keyboarding provided by the company's iPAQ. A red light is used to project a QWERTY-like pattern onto a solid surface to create a virtual keyboard. Devices may then monitor how the user's fingers move while they type by using motion sensors to feed back keystrokes. [25]35 35Posard, Marek N.; Rinderknecht, R. Gordon (2015). "Do people like working with computers more than human beings?". *Computers in Human Behavior*. 51: 232–238. doi:10.1016/j.chb.2015.04.057. 39 40 Recent Advances in HCI Recent developments in HCI research, such as intelligent and adaptable user interface design and ubiquitous computing, are discussed in the following sections. Physical, cognitive, and emotional activity are all involved in these connections. Intelligent and Adaptive HCI Research is focused on developing intelligent and adaptable interfaces, despite the fact that the bulk of people's gadgets are still

command/action setups utilising very simple physical gear. Not everyone can agree on what constitutes "intelligent" in terms of a theoretical definition. These principles may be defined, however, by the apparent expansion and development of new gadgets in market functioning and usability. As previously said, creating HCI solutions that make things simpler, more enjoyable, and more gratifying for users is both economically and technologically critical. The interfaces are growing easier to use every day in order to accomplish this aim.. A nice example of interface evolution is seen in note-taking software. Tablet PCs that allow you to write in your own handwriting using your own handwriting and the tablet recognises it and converts it to text [27] and if not already, tools that automatically transcribe what you say so you don't even have to write at all. Differentiating between employing intelligence in the creation of the interface (Intelligent HCI) [28] and in how the interface interacts with users (Adaptive HCI) [29] is a key aspect in the next generation of interfaces. Intelligent HCI designs are interfaces that integrate at least some type of intelligence in user perception and/or reaction. Speech-enabled interfaces [30] and devices that detect a user's gaze [31] or movement [32] are two examples of this kind of technology that uses natural language to communicate with the user. Intelligent HCI design may not employ intelligence in the interface building process, but adaptive HCI designs may [33] incorporate intelligence into their ongoing interactions with users. Some examples of adaptable HCI are websites that use the standard GUI to offer a wide range of items. Some of this website's adaptiveness can be achieved if it recognises users, keeps track of what they've done in the past, and intelligently finds and suggests things that it thinks they'll be interested in. The majority of these adaptations are focused on the user's cognitive and emotional activity levels [1]. The handwriting recognition capability of a PDA or tablet PC and its ability to adapt to the handwriting of the logged-in user are two further examples of interfaces that employ both intelligent and adaptive features. To sum it up, most non-intelligent HCI designs are passive in nature, meaning they only react when the user calls for them to, but the most intelligent and adaptable HCI designs are active interfaces. Smart billboards or adverts that tailor their presentation to the preferences of the viewers are one such example [34] [35]. After that, we'll take a closer look at how a variety of HCI methodologies may be used to create intelligent, adaptable natural interfaces. Ubiquitous Computing and Ambient Intelligence Unmistakably omnipresent computing is the focus of current HCI research (UbiComp). There are two terms that are often used interchangeably: ambient intelligence and pervasive computing. They both refer to a method for interacting with computers that eliminates the need for a desktop computer and integrates computers into their surroundings, making them virtually indistinguishable to humans. Mark Weiser initially proposed the concept of "ubiquitous computing" in 1998, while he was the head technologist of Xerox PARC's Computer Science Lab. In his vision, computers would be embedded in the environment and ordinary things such that humans could interact with several computers simultaneously while they were invisible to them and wirelessly communicated with each other. [27]. Additionally, UbiComp is also known as the Third Computing Wave. Many individuals had access to a single mainframe computer during the First Wave. One computer per person was used in the Second Wave, and now UbiComp is ushering in the multiple computers per person era [27]. The main trends in computing are shown in the figure. 42 CHAPTER 07 HCI Systems Architecture The configuration is the most critical aspect of an HCI design. In reality, an interface is characterised by the amount and variety of inputs and outputs it offers.. In order to understand how an HCI system works, one must first understand its architecture. The sections that follow describe various interface settings and designs. Unimodal HCI Systems The amount and variety of inputs and outputs, which are communication channels that allow users to interact with a computer via this interface, are the most important aspects of an interface. A modality is the name given to a single independent channel [36]. The term "unimodal" refers to systems that use just one modality. It is possible to categorise various modalities into three broad groups: Visually-Oriented The use of audio recordings Based on Sensors Detailed descriptions and examples of each modality may be found in the following sections, which also provide links to other resources. Visual-Based HCI Human computer interaction (HCI) research is dominated by visual methods. Researchers have attempted to address many elements of human reactions that may be identified as a visual signal, taking into account the breadth of applications and the range of open challenges and techniques. The following are some of the most important fields of study covered in this section: 43 • Analysis of facial expressions • Monitoring of movement (Large-scale) • Detection of gaze and gestures (Eyes Movement Tracking) There is, however, a broad understanding of each subject based on the applications. Recognition of emotions by the visual means of facial expression analysis is the basic focus of this field[36, 37, 38, 39]. It

is in this area that the primary emphasis is on body movement tracking and gesture recognition, both of which may be utilised for a variety of applications. However, they are most often employed for command and action scenarios involving direct human-computer contact. To better comprehend the user's attention, purpose or concentration in context-sensitive scenarios, gaze detection [32] may be used as an indirect interface between the user and the computer. Exceptions are eye tracking systems for people with impairments, where eye tracking plays a major part in command and action scenarios, such as pointer movement or blinking for clicking [45]. A few researchers have sought to use visual techniques to supplement or even replace other sorts of interactions (audio, sensor-based). [46] As an example of a useful assist for speech recognition mistake correction: [46] Lip reading or lip tracking.³⁸ Audio-Based HCI

Another key aspect of HCI systems is the audio-based interaction between a computer and a person. This section is dedicated to the analysis of data derived from various types of audio sources. Even while auditory signals aren't as varied as visual signals, the information acquired from them may be more trustworthy and valuable, as well as in certain instances unique sources of information. In this section, you'll find the following subcategories: ³⁸SUPRA14 44 Audio Emotion Analysis (A.E.A.) Speech Recognition Noise/Sign Detection Caused by Humans (Gasp, Sigh, Laugh, Cry, etc.) Involvement in music Researchers have traditionally focused on voice recognition and speaker recognition. Initiatives to include human emotions into intelligent human-computer interaction have sparked efforts to analyse emotions in audio signals. Sighs, gasps, and other common human audio indicators have aided emotion analysis in the development of more intelligent human computer interfaces (HCI) [50]. The study of music creation and interaction in HCI systems, both auditory and visual, is a relatively recent development with applications in the art sector [51].

Sensor-Based HCI A number of topics and applications are covered in this section. At least one physical sensor is required between the user and the machine in order for the interaction to occur. There are a variety of sensors listed below that may be simple or quite complex. Pen-to-Paper Communication Keyboard and mouse Third-party controllers Sensors and Digitizers for Motion Tracking Haptic Sensors Sensors that measure pressure Senses of Taste and Smell They have been present for some time, although some of these sensors have just been introduced. pen gesture [30] and handwriting recognition areas of interest in mobile devices are the focus of pen-based sensors (PBS). Section 3.1 of this guide covers the basics of keyboards, mouse, and joysticks. See [8] [9] [10] [11] for further details. Sensors and digitizers for motion tracking are cutting-edge technologies that have changed the video-game and animation industries. Wearable sensors, whether in the form of clothing or joints, have improved computers' ability to interact with the actual environment and given humans the ability to digitally build their own worlds. Such a gadget is seen in Figure 3. For robots and virtual ⁴⁵ reality, haptic and pressure sensors are of particular relevance. At [15], [16], [18]. There are hundreds of haptic sensors in new humanoid robots that allow the robots to be sensitive and aware of touch. A medical surgical application also makes use of these sensors. [54] Taste and smell sensors [55] are also the subject of some study, although it is not as common as in other areas.³⁹ ³⁹Ibid 46 Multimodal HCI Systems Using a mix of several modes is what is meant by the word "multimodal." MMHCI systems use these terms to describe how the system reacts to inputs, i.e. communication channels. Sight, Hearing, Touch, Smell, and Taste are the primary human senses that define these routes of communication. These are just a few examples of how you may engage with a machine. The regular keyboard and mouse aren't the only ways of input available when working with a multimodal interface. Multimodal systems may differ greatly in the number of input modalities, their characteristics, and how they interact together. As a result, multimodal interfaces allow for a wide range of input methods to be used simultaneously. As far as input techniques go, gesture and voice are two of the most widely supported combinations. Multimodal HCI systems in theory should combine single modes that interact with one other, however real limits and unsolved challenges in each mode prevent this from happening. Despite the advances achieved in MMHCI, most contemporary multimodal systems still handle the modalities independently and only at the end mix the findings of many modalities together. For this reason, there is still work to be done to obtain a dependable tool for each subsector, since the open challenges in each field have yet to be perfected. It's also unclear what the responsibilities of various modalities are and how they interact with one another. "Yet, humans use several modes of communication to communicate in a redundant and complimentary way. A context-dependent model must be used to process the input data in a joint feature space, rather than being processed independently of one another, in order to achieve a human-like multimodal analysis of various input signals received by distinct sensors. In reality, however, one must deal with the size of the needed joint feature space in addition to context

sensing and constructing contextdependent models for merging multisensory information. Large dimensionality, varying feature formats, and timealignment are all causes for concern [36]. " 47 Multimodality has an important feature: the use of many modalities to aid in the recognition process. As an example, lip movement tracking (visual-based) may support speech recognition techniques (audio-based), and speech recognition methods (audio-based) can assist command acquisition in gesture recognition (visualbased). The following section provides examples of how intelligent multimodal systems have been put to use. Applications This demonstration system for "Put That There" is a famous example of a multimodal system. "Put that there" might be used to relocate an item to a new spot on a screen map by saying "put that there" and then pointing to the desired location. Map-based simulations, like the aforementioned system, as well as information kiosks like AT&T's MATCHKiosk and biometric identification systems have all made use of multimodal interfaces. The benefits of multimodal interfaces over standard interfaces are many. When it comes to the user's experience, they may be more natural and user-friendly. Real Hunter is a real-estate system that lets users point and talk at a specific property to get information about it. The natural experience that multimodal interfaces provide to their users is shown by the employment of a pointing motion to choose an item and the use of voice to ask enquiries about it. As a further benefit, multimodal interfaces are able to offer redundancy to suit a diverse user base. For example, MATCHKiosk enables you to search for a company type using voice or handwriting. As a result, rather of speaking, one may give input in a loud environment via scribbling. The following are a few examples of how multimodal systems may be used: Video Conferencing using Smart Phones and Tablets Smart Offices/Homes Driver Monitoring 48 Playing games with intelligence E-Commerce Assisting those with disabilities A number of noteworthy multimodal applications have been discussed in further depth in the following sections. Multimodal Systems for Disabled people Multimodal systems may be used to address and help handicapped individuals (such as those with hand problems), who need interfaces that are different from those used by the general population. Disabled people may utilise speech and head motions to communicate with the PC in such systems. The system shown in the following figure is a real-world example. 49 Speech and head gestures are then used. Both modes of communication are always in use. Using the location of the mouse cursor's head, you may see where it is now located on the screen. If a cursor selects an item, speech tells the user what they need to do and why they should do it. The cursor location at the commencement of speech detection is used to calculate the synchronisation between the two modalities. For one thing, a person may move his or her head and then move the pointer to another graphical object; this is a common occurrence while a person is speaking. Additionally, the instruction that must be completed appears in a person's brain before he or she begins speaking. In Figure 5, you can see a schematic representation of this system. It is possible to operate on a computer without a mouse or keyboard utilising the multimodal assertive system despite minor slowdowns in performance. As a result, individuals with physical limitations may utilise this technology to manage their PCs without having to use their hands. 50 Emotion Recognition Multimodal Systems As computers grow increasingly prevalent in our lives, it will be critical that they be able to recognise and understand all of the cues we provide them about our intentions. It is impossible to have a realistic human-computer connection based purely on orders that are openly given. Computers will need to be able to discern a person's emotional state based on a variety of behavioural clues. To be able to effectively forecast one's intents and future behaviour, one must put this important piece of the jigsaw together. Emotional states may be inferred from a person's facial expressions, body language, and vocal tones. Faces are the greatest predictors if only one of these modalities is available, according to studies. Human judges who have access to both facial and bodily modalities may boost accuracy by 35% [66]. Although most studies have focused on facial expressions, this shows that multimodal fusion approaches may considerably improve affect recognition. In an effort to create an indication of annoyance, [67] combines face traits and body posture features in one work, one of the rare attempts to integrate more than one modality for affect identification. Similarly to people, computer categorization of emotions is better when based on both facial and body data, rather than either modality alone, as shown in [68]. Affect recognition was attempted in [69] by combining face and speech data. It was shown that combining the face and voice data improved the machine's ability to accurately classify emotions as neutral, sad, angry, or pleased. Sadness, anger, joy, and neutrality were the four feelings that were recorded. Detailed face gestures and simultaneous speech recordings were used to capture the motions. Researchers concluded that face recognition outperforms auditory information alone in terms of performance. Using a combination of both techniques yielded even better results. A facial

expression recognition system achieves an overall performance of 85%, whereas an acoustic information-based system achieves just a 70.9 percent overall performance. Emotion categorization is aided by the fact that the cheek region provides valuable information. 51 On the other hand, the total performance of this classifier was 89% for the bimodal system based on the combination of face recognition and audio information. Map-Based Multimodal Applications Messages may be sent in a variety of ways using a variety of input modalities. Speech, for example, is a simple and natural way to express a question about a certain item or to request that the object do a specific action. For activities like selecting a specific area of the screen or drawing a specific route, voice may not be the best option. Hand or pen motions are more suited for these kinds of jobs. Mapbased interfaces are well-suited for common operations like doing searches on a specific area and choosing that area from a list of available areas. Map-based interfaces may thus naturally enhance the user's experience by enabling numerous input types, including voice and gestures. This conclusion is logical. Map-based application Quickset [70] is one of the most well recognised and oldest map-based apps that use voice and pen motion input. Military-training software Quickset enables users to utilise one or both of the two modalities to communicate a whole command simultaneously. To establish a platoon, for example, a user may simply draw a preset symbol for platoons on the map and place it where they want it. For those who prefer this method, they may speak out loud their desire to create a new platoon and the coordinates where they want it to be placed. Finally, users might use a pointing motion with a pen to indicate the position of a new battalion while verbally expressing their intention to do so. Real Hunter [24] is a more modern multimodal map-based application. It's a real estate interface that relies on touch and vocal input to let users pick items or areas. The user may, for example, point to a home on the map and ask, "How much is this?". It has been proven that multimodal interfaces may greatly improve the usability of various types of map-based apps, such as tour guides. The interactive city guide MATCHKiosk [58] is one such example. Quickset-like MATCHKiosk lets you 52 express specific inquiries using voice solely, such as "Find me Indian restaurants around Washington."; by circling a region and writing down "restaurants"; or by stating "Indian restaurants in this area" and drawing a circle around Alexandria. These examples show how handwriting recognition in MATCHKiosk may often replace verbal input. Because speaking isn't always flawless, particularly in loud settings, having handwriting as a backup alternative might help users feel less frustrated.

CHAPTER 08 CONCLUSION The design of systems must include consideration of human-computer interaction. Systems are judged on how they are perceived and utilised by their end users. Because of this, a great deal of work has been given to improving HCI designs. Researchers are refocusing their efforts in order to develop ways of interaction that are more natural and intuitive, while also being more intelligent, adaptable, and multimodal. The Third Wave, also known as ubiquitous computing or ambient intelligence, is attempting to blend technology into the environment in order to make it seem more natural and unnoticeable. An emerging HCI discipline, virtual reality, has the potential to become the common interface of the future. This study sought to offer an overview of these topics and a full reference list of previous research. 53

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