

# CHARTING THE COURSE OF HCI: A REVIEW OF SEVEN GRAND CHALLENGES

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## Abstract

Nowadays, the need for Human-Computer Interaction (HCI) is important to facilitate and meet human needs in the world of work and daily life. The purpose of this article is to review and identify the seven main challenges in Human-Computer Interaction (HCI) namely Human-Technology Symbiosis; Human-Environment Interactions; Ethics, Privacy and Security; Well-being, Health, and Eudaimonia; Accessibility and Universal Access; Learning and Creativity; and Social Organization and Democracy. Therefore, this article has used a qualitative approach which is by review of articles. All of the discussion and comment on the content are only based one of the journal writings that have been carried out related to the topic of discussion.

**Keywords:** Grand Challenges, Human-computer Interaction, Review

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# PENCARTAAN KURSUS INTERAKSI MANUSIA- KOMPUTER: ULASAN TERHADAP TUJUH CABARAN UTAMA

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## Abstrak

Ilmu Interaksi Manusia - Komputer (HCI) adalah penting pada masa kini bagi memudahkan dan memenuhi keperluan manusia dalam dunia pekerjaan dan kehidupan seharian. Artikel ini bertujuan untuk mengkaji dan mengenal pasti tujuh cabaran utama dalam bidang Manusia dan Komputer iaitu Simbiosis Manusia-Teknologi; Interaksi Manusia-Persekitaran; Etika, Privasi dan Keselamatan; Kesejahteraan, Kesihatan dan *Eudaimonia*; Kebolehcapaian dan Akses Sejagat; Pembelajaran dan Kreativiti; dan Organisasi Sosial dan Demokrasi. Justeru, kajian ini menggunakan pendekatan kualitatif iaitu secara ulasan artikel. Segala perbincangan dan ulasan terhadap isi kandungan hanya berdasarkan salah satu penulisan jurnal yang telah dijalankan berkaitan tajuk perbincangan.

**Kata Kunci:** Cabaran besar, Interaksi Manusia - Komputer, Ulasan

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## 1.0 Introduction

Human-Computer Interaction (HCI) is an interdisciplinary field that strives to develop user-friendly and effective interactions between computers and humans. HCI combines methods and knowledge from various disciplines such as computer science, design, sociology, psychology, and human factors engineering. The goal of HCI is to create an interaction that meets the users' requirements, has efficient and smooth interaction between humans and computer technology, and brings enjoyment. According to Prihati, Mustafa, & Suhartono (2011), human-computer interaction (HCI) is a scientific discipline that studies communication or interaction between users and systems. HCI also involves the study of how computer technology affects human work and activities. As we know, the primary role of HCI is to create a system that is practical, secure, productive, useful, efficient, and functional. Shneiderman et al. (2016) in their article "*Grand Challenges for HCI Researchers*" analyzed the importance of HCI in addressing significant impacts on societal concerns, emphasize the need for enhanced interdisciplinary approaches emerging from engineering, science, and design, and also outline 16 key challenges related to societal issues as well as technology.

HCI has its own goals which bring many benefits to human life. One of the primary objectives of HCI is to develop technology that is easy to use. This consists of creating user interfaces that are simple to navigate and understand so that users may accomplish jobs with minimal work and mistakes. The second important goal of HCI is to make technology usable to a wide range of users. This involves creating interface designs that are accessible to people of all ages, abilities, and cultural backgrounds. Next, making technology useful is a third goal of HCI. This entails creating user interfaces that accommodate user requirements and goals while also providing them with the knowledge and resources that they need to accomplish their work. A fourth goal of HCI is to make the technology appealing. This includes establishing visually attractive and engaging interfaces that provide a satisfying experience for users. Finally, technology must be made secure and safe. This includes creating user interfaces that are simple to use while also protecting users' security and privacy. As technology advances, the field of HCI will become progressively important in ensuring that technology is intended to fulfill the requirements of users while also positively influencing society.

The article being analyzed and reviewed is titled 'Seven HCI Grand Challenges' by Stephanidis et al. (2019). This article was published to investigate the grand challenges that emerge in the current and emerging environment of rapid technological evolution towards more smart interactive technologies, accompanied by rising and widened society's needs, as well as individual and collective expectations that HCI was called upon to address. The examination of the major challenges in this journal has been identified through seven challenges namely Human-Technology Symbiosis; Human-Environment Interactions; Ethics, Privacy and Security; Well-being, Health and Eudaimonia; Accessibility and Universal Access; Learning and Creativity; and Social Organization and Democracy. All the challenges in this article had been analyzed in terms of concepts, problem definitions, key research issues involved, and state-of-the-art and related emerging needs. A large group of research experts joined in discussing this issue by summarizing the research priorities and views that have been conducted by a group of international disciplinary experts.



Seven HCI Grand Challenges elaborated on the seven challenges in greater depth and includes a discussion of the challenges underlying issues. The examination of these difficulties is highly pertinent to the current trend of evolution of the norms of modern society, which is significantly dependent on the use of technology in normal daily work activities. Nevertheless, in support of the authors' opinions, the use of more than five-year-old arguments was deemed less adequate because some items were no longer acceptable in 1991, the year the survey was done. The materials of Seven HCI Grand Challenges are regarded as particularly intriguing and packed with information, as it included a long discussion supported by a variety of sources from prior studies, as opposed to relying just on the invention of one's own arguments and viewpoints.

## **2.0 Purpose of the Study**

This article aims to summarize and elaborate on the Seven Grand Challenges of HCI as well as the impact of HCI on society, economy, and culture. In addition, this paper will also comprehensively discuss the seven main challenges of HCI that arise in the environment of human life and also discuss the impact of HCI on society, the economy, and human cultures.

## **3.0 Summary of the Seven Hci Challenges**

Through this journal, there were seven challenges that have been identified as a result of presentations and opinions submitted by a group of experts of caliber in terms of Human-Technology Symbiosis; Human-Environment Interactions; Ethics, Privacy, and Security; Well-being, Health, and Eudaimonia; Accessibility and Universal Access; Learning and Creativity; and Social Organization and Democracy.

The first challenge that has been stated in this journal was from the aspect of Human-Technology Symbiosis. This journal interpreted the Human-Technology Symbiosis as a reference to how humans will live and work in harmony with technology. This journal also notes that the phrase "Human-Computer Symbiosis" was established by Licklider, J. C. (1960), who predicted a future in which the human brain and automated computer systems interact. It also outlined how a symbiotic connection can be developed between humans and technology by encouraging real human control, which is supported by technical openness, accountability, and the ability to understand. According to Bibri, S. E. (2015), this symbiotic relationship requires a number of considerations, including integrating humanity into design decisions and trade-offs, for example, between technology and human monitoring, and working critically. Several key issues have also been identified as contributing to this set of challenges, namely meaningful human control, human digital intelligence, adaptation and personalization to human needs, Human skills 'support, emotion detection and simulation, human safety, and cultural shift. An explanation of this first challenge is able to prove that the human relationship with technology is very close because technology has made a great contribution to human life such as in the field of services, medicine, communication, and so on.

Next, the second challenge was Human-Environment Interaction. Human-environment interaction is the interaction of humans with the entire technological ecosystem, including enhanced interactivity and knowledge. Human-environment interaction (HCI) has been proposed by Streitz, N. A. (2007) as a replacement for human-computer interaction



(HCI), as individuals would increasingly encounter groups of devices that make up smart surroundings. In a technologically advanced, autonomous, and smart environment, interactions will automatically become more explicit and commonly concealed in the area between the digital and physical worlds. Recent technology developments have already formed a larger interface design area, whereby an idea and concept of interfaces obtain new perspectives and the additional method is significantly more complex (Janlert & Stolterman, E. 2015). The authors explained the topic of supporting human interaction in this environment brings new implications and challenges. Among the challenges of concern arising from interaction-related issues are interactions in the physical and digital continuum, implicit interactions, novel and escalated interactions, interactions in public spaces, interactions in virtual and augmented reality, and evaluation. Clearly, the authors noted that nowadays, the technology used outside the organizational context of user interfaces was far beyond desktop metaphors, and these interactions evolved from keyboards and pointers to touch and gestures. It is possible to think about interaction design as "creating relationships between people and the rest of the world, and consequently, designing the essence more about how we live our lives", (Verbeek, P. P. 2015).

The third challenge was from the aspects of Ethics, Privacy, and Security. According to the definition of the third challenge in this journal, Ethics, Privacy, and Security are the moral principles that determine the behavior of operations within the context of HCI, particularly design. This journal also listed several issues related to this challenge, namely from the aspects of Fundamental privacy concerns, HCI research, Online Social Networks, Healthcare technologies, Biometrics, Virtual Reality, IoT and Big Data, Intelligent environments, and Cybersecurity. In summary, this research emphasized that a smart system must implement security and privacy in order to protect user information from any information theft activities. This journal also stated that an intelligent system needs to behave so that it can benefit humans more than simply achieving functional goals or addressing technical problems, by providing serving human rights and values to their users. However, designing a security system is very challenging and requires time to develop the system. This statement coincides with the opinion of Sicari, Rizzardi, Grieco, & Coen-Portisini, A. (2015), which mentioned that security is a difficult task, particularly because a large number of interconnected devices elevates scalability concerns, rendering conventional security countermeasures ineffective. Therefore, in designing the system must be functional, implement security features and be able to benefit users by providing services that can guarantee the privacy and rights of users.

In addition, the fourth challenge discussed in this journal was in terms of the context of Wellness, Health, and Eudaimonia. This journal defined Health as more than just the presence of disease or infirmity; it also referred to a person's whole physical, mental, and social well-being. On the other hand, achieving the highest level of life satisfaction, enjoyment, affluence, and a sense of purpose or meaning is a component of well-being. Eudaimonia refers to a condition of perfection that a person achieves over the duration of their life and that is brought about by using moral principles, common sense, and reason. In the current era of technological sophistication, the use of information technology in the field of medicine plays an important role in ensuring a healthy, prosperous quality of human life. The journal also notes advances in medicine offer opportunities to provide more effective and cheaper ways to foster healthy living, by encouraging and supporting healthy behaviors, promoting disease prevention, offering



new forms of therapy, and managing chronic disease. There are several issues that have been identified and presented in this fourth challenge, namely from the perspective of Personal Medical Devices and self-tracking, Serious games for health, Ambient Assisted Living, Intelligence in healthcare, Well-being, and Eudaimonia. So, we can say that modern technology brings so many benefits to society. In the context of medicine, technology is able to provide more effective and efficient treatment to patients. Now hospitals and clinics use computers to keep patient records, schedules of doctors, nurses, and other staff, inventory, purchase of medicines, medical research, and even medical diagnoses. It turns out that the use of computers in medicine provides solutions to complex problems.

Accessibility and Universal Access were the fifth challenge that has been explored in this journal. The design of a product, device, service, or environment that is suitable for a person who has a disability is referred to as accessibility. The term "universal access" describes how everyone, everywhere, at any time, can access and use information technology. This journal explained some issues that arise including the adoption of proactive approaches, population aging, accessibility in technologically enriched environments, methods, techniques, and tools, and universal access in future technological environments. The accessibility level has generally increased in terms of accessibility and universal coverage due to advancements in technology. Also, it can assist people in raising the standard of living for a number of groups, including the elderly and the disabled. Technology accessibility has aided human advancement towards wealthier and healthier living standards. This factor is also regarded as a crucial element in numerous services and day-to-day activities that guarantee the stability of society over the course of time.

Likewise, the sixth challenge, Learning and Creativity, is also a significant area of focus in the field of HCI. According to the article's definition, learning is the action or method by which one acquires information or abilities through experience, practice, instruction, or any combination of these. Creativity is the capacity to come up with innovative and distinctive ideas as well as to invent anything fresh or creative. The research in this journal has demonstrated how new technologies have the ability to promote the new learning habits of the modern generation, which has been inspired by the abundance of technology in daily life. Learning enabled by digital technology entails studying anytime and anywhere (Hwang, G. J., & Tsai, C. C. 2011). Several issues have been identified through this sixth challenge, among others from the aspects of the new generation of learners, Extended Reality, Mobile learning, Serious games for learning, Intelligent environments, Pedagogical impact of learning technologies, and Creativity. Issues in learning and creative challenges to the application of HCI in learning are seen as less encouraging as the author described this method as having triggered disruption to learning and pedagogical goals.

Other causes include students' decreasing interest in technology, challenges in producing content, creating learning activities that fit formal and informal contexts, as well as virtual and physical worlds, and so on. However, not all issues are viewed negatively; there are a lot of positive issues regarding the use of HCI in learning. For instance, this journal has stated that the positive effect of technology use has the potential to encourage and support new learning styles, creative learning, and continuous learning. Digital learning



environments may well encourage context-aware and ubiquitous learning by recognizing learners' situations and providing integrated, interoperable, prevalent, and immersive learning environments (Mikulecký, P. 2012). Today, the advancement of HCI technology is now seen to bring positive prospects in the world of learning where this phenomenon has shaped a more creative learning environment by providing a conducive learning environment to society.

Finally, the last challenge was from the aspect of the challenge of Social Organization and Democracy. By definition, as stated by the authors, Social organization was the development of a reliable connection structure within a group that forms the cornerstone for the group's efficient operation. Democracy is a system of government where citizens have the freedom to make their own decisions and where those selected by the general public hold the executive (also known as administrative) and legislative (also known as legislative) branches of government. Harding, Knowles, Davies, & Rouncefield, M. (2015) assumed that ubiquitous technology encourages and facilitates citizen involvement and collaboration. Issues in the context of this seventh challenge are classified into several key issues namely Sustainability, Social justice, Active citizen participation, and Democracy. This journal also analyses how new technical developments affect democracy. The development of effective design techniques and structures for the development of social justice, as well as citizen social involvement and democracy via technology, has been made possible because of advances in technology. As a result, HCI research is crucial to the advancement of technology as well as to solving significant social and environmental problems. Furthermore, protection will be the inherent qualities of democracy, tolerance, wealth, and sustainability.

#### **4.0 Methodology**

In producing this article paper, the review of articles has been used as a research methodology whereby the discussion of the content of this paper was based on observations and studies from previous research. The focus of the content discussed in producing this paper is to identify the seven grand challenges in HCI as well as the impact of HCI on society, economy, and culture. A journal entitled "*Seven HCI Grand Challenges*" written by Stephanidis et al. (2019) will be discussed and critically reviewed in this paper.

#### **5.0 Discussion**

Today's society is mediated by information and communication technologies (ICT) (Salgado, L., Pereira, R., & Gasparini, I. 2015). Human-Computer Interaction (HCI) is a crucial and effective issue in daily life. Human-Computer Interaction (HCI) is also concerned with providing and promoting scientific knowledge of the interactions that occur between humans and the Computing Informatics technology and tools that we implement (Singh, 2017). HCI aims to figure out how these technological advancements can become more accessible and responsive to user requirements. The user experience and user interface are essential to human-computer interaction. One of the primary areas of study in HCI is how humans interact with computers and devices. We can see that there are various examples of HCI that are used in our daily life without us realizing it. Among them are Windows, Icons, Menus, and Pointers (WIMP). WIMP is a graphical user interface for computers that use windows to display various icons (Singh, 2017). The



Graphical User Interface (GUI) employs graphics to assist users when using computers. The Graphical User Interface (GUI) gives the user an intuitive way to access a program's features; Microsoft Word heavily relies on (GUI) for its toolbars and dialogue boxes (Singh, 2017). Another example is Web User Interface (WUI). A browser-based Web User Interface (WUI) is an excellent method for implementing and monitoring network security components. Administrators and users are already familiar with the use of a web browser to better access (Singh, 2017). Human-Computer Interaction (HCI) has also grown to encompass almost every aspect of information and technology design. It is critical to design interactive computer systems that are effective, simple, efficient, and enjoyable. One important consideration in human-computer interaction is that different users have different perceptions and mental models of their interactions. They also learn and retain knowledge and skills in various ways.

Indeed, as we live in a globalized world, we commonly communicate directly with technology in a wide range of situations and environments such as work, school, leisure, relationships, and so on (Salgado, Pereira, & Gasparini, 2015). Human-computer interaction (HCI) provides a positive effect on culture, economy, and society. It has inspired new thinking, making today a better and more developed time to live. Some think that virtual reality will replace our current reality since it creates a new experience for everyone, including disabled users, able to live a normal lifestyle free from any limitations. As we know, HCI is of critical importance because it makes systems more usable, helpful, safe, and functional. It provides an easy and pleasurable user experience, rather than abandoning the user disappointed as they attempt to figure out the reason why the system isn't working as expected or performing the tasks, they expect it to do. Human-computer interaction is critical to preventing systems from failing entirely. It creates systems more user-friendly, understandable, and valuable to people.

In this Computing Informatics Era, Human-Computer Interaction (HCI) has had a dramatic impact on people's economies, cultures, and social lives. HCI is also another important area of research that promotes well-being for people, society, and Ecosystems (Coventry, L. (2012). HCI has had a tremendous effect on society over the centuries, attempting to make using computer devices very much relatively easy for everybody to utilize. The most widespread impact of HCI on society has been to make routine life simpler by enhancing the convenience of the use of computers and other devices. Current technology can now be used by people who have never had any training. Due to the advancement of modern HCI, computers are becoming more accessible to people and are being used in daily life (Singh, A. K. (2017). We can see that HCI is having a significant impact on society now, which means that most computer equipment will be easy to use for persons with disabilities. Designing user interfaces is an example of how HCI is used in society. Interfaces have now been developed to make utilizing computers, mobile devices, and tablets simple to use. The objective of interface designers is to design an interface that is straightforward and simple to use for the user. For instance, touchscreen technology is currently quite ubiquitous, and portable technology like mobile phones and tablets has also become very common. Now, the use of touch screens has made it much easier to message people, with a qwerty keypad on the screen that lets the user type by touching the note once. This also assisted those who have physical impairments, as they no longer need to use a mouse or a physical keyboard since we can now control our devices with the touch of our fingers. Highly specialized interfaces have now been developed for users who might have visual acuity or speech problem





Another example that we can see is the use of voice recognition. Voice recognition software lets the user communicate with the computer via a microphone in order to type text. The system takes whatever the user says and translates it into text that appears on the screen as if the user is typing it. People became very interested in it, and it is now a component of our daily lives. Humans utilize it with ease and it assists us to get through our everyday life. An example of this type of software is SIRI which is known as a software program developed by Apple. Here, SIRI can be found on the majority of Apple devices, including the iPad, iPhones, and iPod touch. Pressing the home button will bring up this feature. In this case, the device can assist users in finding information without requiring them to type anything. What makes SIRI such a great tool is that it will literally voice to us any information it finds, which is helpful for people with impaired vision. As a result, people with any kind of disability, including those related to sight, physical ability, or learning, are able to utilize computers in the same way as normal people.

Today, HCI has had a significant impact on the economy by purchasing and selling products, and one of the main reasons is due to the use of robotic systems in the working place. By utilizing machines in the working place, more work can currently be done, and also most jobs are increasingly productive. However, utilizing machines in the working place had a serious effect due to increased unemployment rates because a growing number of people are finding it difficult to find work because the more basic tasks, such as till check out, are currently done by machines. Through technologies like digital machines, it is significantly less costly to operate departments like service delivery. This is because it will inform the user of the data that they want, which is frequently encountered on a database, customer service may be done by a machine and doesn't require much human control.

In addition, there are several speed-up inputs available anywhere right now to assist users. We can see a supermarket as an instance of a speed-up input. A person can benefit from this because they're able to use a scanning bar code sensor to understand more about an item in detail at any time. They can simply scan the item's bar code with the smartphone. People will be able to purchase considerably more quickly and effectively. People who have disabilities will be able to participate in all across the globe thanks to HCI's economic influence, which will also make it easier for them to work and do other jobs. HCI has caused a paradigm shift at work since it has given us more options for how to perform our jobs. Internet connection is included in this. Enabling the user to access their computer from a mobile phone, tablet, laptop. It has already helped make work become more efficient. As a result, work can potentially be conducted nearly anywhere in the world.

Next, culture has had a significant impact because it has brought people from all over the world together. Translators are one example of how HCI has influenced the culture. Google Translate has enabled people to communicate with each other by enabling them to type in their native language and get it translated into other languages so that people can understand. This might have enabled people to communicate across cultures and languages. Laptops have had a significant impact on the culture due to the fact that these tools have grown cheaper over time, and most people nowadays will have one, whether used at work or at home. A laptop's portability makes it easy to carry anywhere, which makes it perfect for those who are traveling but still need access to a computer or internet networking. By using this method, individuals also can schedule meetings via text



rather than by phone or email. Due to the fact that this method of communication is more immediate and efficient, everything becomes much faster to complete.

Furthermore, HCI also has an implication on gaming culture. HCI has changed the way we purchase and play video games. Nowadays, instead of laptops, we will use tablets like the iPad for gaming and entertainment. Another manner in which HCI has influenced mobile entertainment. This is due to the fact that it is now possible to watch our favorite movies on our smartphones or tablets without having to use a TV. It also helps to make watching shows more customization. New streaming sites, such as Netflix and YouTube, have emerged in the entertainment industry. This new site allows people to stream their favorite movies, and music there for a minimal charge. The requirement for a variety of work skills has decreased as a result of new HCI developments. Robots are used by some industrial organizations to develop things that must be placed in large quantities. Because of this, the workforce is less specialized. Automatic technologies may make labor less challenging, which could lead employees to feel underappreciated and unmotivated.

## 6.0 Conclusion

Conclusively, based on the discussion through this article it can be decided that the content of the topic of this article is very good and interesting because this article provides a description in more detail. In addition, this article is also very suitable to be used as a reference and guide to any researcher who wants to conduct research on related topics. This article has also provided very useful exposure to the readers to increase their knowledge and develop research ideas. Each challenge that has been identified is also discussed once the issues that arise in the challenge and this matter has been able to provide a comprehensive understanding to any researcher who wants to do research. It is hoped that this article can be a very useful and beneficial reference to researchers in the future. Proposals for future research hopefully research on such topics of discussion will continue to be studied and developed more widely.

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