

Human-Computer Interaction: A Systematic Review

Paras Jain
School of Computing Science and
Engineering
VIT Bhopal University
Sehore, Madhya Pradesh, India
paras.jain@vitbhopal.ac.in

Vishan Kumar Gupta
Department of Computer Science
Amity University Punjab
Mohali, India
vishangupta@gmail.com

Harish Tiwari
Department of CSE
Sir Padampat Singhanian University
Udaipur, India
harish.tiwari@spsu.ac.in

Anurag Shukla
School of Management
Sir Padampat Singhanian University
Udaipur, Rajasthan, India
anurag.shukla@spsu.ac.in

Priyank Pandey
Department of CSE
Graphic Era Deemed to be University
Dehradun, UK, India
priyankpandeyrc@gmail.com

Ashutosh Gupta
Department of CSE
Sir Padampat Singhanian University
Udaipur, Rajasthan, India
ashubit105@gmail.com

Abstract—This paper presents an overview of the significance of Human-Computer Interaction (HCI) in modern technology and its influence on different fields. The study of HCI involves understanding how people interact with technology and the various techniques and methodologies used to make technology more user-friendly. The paper aims to explore the applications of HCI in different areas such as education, entertainment, and healthcare. The field of HCI is crucial in the development of technology that is not only innovative but also user-friendly. With the advancement of technology, HCI has become increasingly important in ensuring that technology is designed to meet the needs of users. HCI techniques and methodologies, such as user-centered design and usability testing, have become essential in developing technology that is designed with users in mind. The applications of HCI in different fields. In education, for example, HCI can be used to develop learning management systems that are engaging and interactive for students. By incorporating HCI principles in the design of these systems, educators can create a more effective learning environment that is tailored to the needs of students.

Keywords—human-computer interaction, user-centered design, usability testing, education, entertainment, healthcare.

I. INTRODUCTION

The field of HCI has grown in importance as technology continues to impact our daily lives. As we increasingly rely on technology for communication, entertainment, education, and healthcare, the interaction between humans and computers becomes more critical in determining the effectiveness of technology. The study of HCI has become crucial in creating technology that is intuitive, user-friendly, and accessible. HCI involves various techniques and methodologies, including user-centric design and usability testing, that are used in the design and development of interactive systems and interfaces. By understanding the needs and requirements of end-users and testing technology in real-world scenarios, HCI ensures that the technology meets the expectations of users and provides an optimal user experience [1].

The applications of HCI are vast and impact numerous fields, including education, entertainment, and healthcare. In education, HCI has enabled the creation of interactive learning environments that engage students and enhance the

learning experience. Through the use of technology, such as e-books, virtual classrooms, and educational games, HCI has transformed traditional classroom learning into more accessible and engaging experiences.

Similarly, HCI is essential in the entertainment industry as it helps developers to create immersive experiences that engage users. From virtual reality to video games, HCI can be used to create technology that delivers a more enjoyable experience for users. The development of virtual and augmented reality technologies has revolutionized the gaming experience, providing users with more immersive and interactive experiences. Interactive movies, which allow audiences to control the storyline and engage with characters, have also been developed through the application of HCI principles [1].

HCI is also crucial in the healthcare industry, where it is used in the design of medical devices and other technologies that are easy to use for patients and healthcare providers. In healthcare, HCI has become a crucial tool in creating innovative ways to diagnose and treat patients. Wearable devices and mobile apps have empowered patients to monitor their health and receive personalized treatment. Telemedicine, which allows for remote access to medical services, has also been made possible through the application of HCI principles, reducing the need for physical visits to the hospital [2].

While HCI has numerous advantages, it also has its drawbacks. The complexity of technology can make interfaces overwhelming and challenging to use, resulting in poor user experience. Developing user-friendly interfaces can also be expensive, making it challenging for smaller companies to compete. Additionally, as we become increasingly reliant on technology, malfunctions or failures can have significant consequences. HCI has also made significant contributions to the field of user experience (UX) design. UX design involves the creation of user-friendly interfaces that enhance the user's overall experience with technology. Through the application of HCI principles, UX designers can create interfaces that are intuitive, easy to navigate, and aesthetically pleasing. Good UX design is critical in ensuring that users enjoy using the technology and can accomplish their goals quickly and efficiently [3].

Another area where HCI has had a significant impact is in the development of assistive technology for individuals with disabilities. HCI principles are used to design interfaces and devices that are accessible to people with visual, auditory, and motor impairments. This technology helps to remove barriers to accessing information and communication, enabling individuals with disabilities to participate more fully in society.

Despite the many advantages of HCI, there are also some disadvantages that need to be considered. For example, as technology becomes more complex, the interfaces can become overwhelming and challenging to use. Developing user-friendly interfaces can also be expensive, making it challenging for smaller companies to compete. As technology becomes more integrated into our daily lives, we become increasingly reliant on it, which can be a disadvantage if it malfunctions or fails. Additionally, security risks also increase, posing a threat to user privacy and personal information [4].

The study of HCI has become increasingly important as technology continues to impact our daily lives. By focusing on understanding the interaction between humans and computers and designing technology that is intuitive, user-friendly, and accessible, HCI has transformed various fields such as education, entertainment, and healthcare. While HCI has its disadvantages, the advantages of creating technology that meets the needs and expectations of users cannot be overstated. The field of HCI plays a vital role in creating technology that is accessible, effective, and user-friendly. Through the application of HCI principles, technology can be designed to meet the needs and expectations of users, resulting in improved user experience, increased efficiency, and enhanced productivity. The study of HCI involves various techniques and methodologies that are used in the design and development of interactive systems and interfaces. HCI has significant applications in various fields such as education, entertainment, and healthcare, and has made significant contributions to the field of UX design and assistive technology. While there are some disadvantages to HCI, the advantages far outweigh them, making HCI a crucial field of study for the development of technology in the modern world. The following points discuss the importance, need and role of HCI in technology innovation and development [5].

A. The importance of user-centric design:

User-centered design is an essential methodology in HCI research as it prioritizes the needs and perspectives of users in the design process. By incorporating user feedback and involving users in the design process, researchers and designers can create systems that are tailored to the needs of users. This approach can lead to improved user satisfaction, increased efficiency, and better system performance.

B. The need for continued research in HCI:

As technology continues to evolve, it is essential to conduct research in HCI to ensure that technology is designed to meet the needs of users effectively. The development of emerging technologies such as virtual reality, artificial intelligence, and machine learning requires further research to ensure that they are designed with user needs in mind. Moreover, as technology becomes more integrated into everyday life, there is a need to consider ethical, social, and cultural implications in HCI research.

C. The role of HCI in technology innovation and development:

HCI plays a crucial role in technology innovation and development as it ensures that technology is designed to meet the needs of users. By incorporating HCI principles in the design process, researchers and designers can create systems that are more efficient, effective, and user-friendly. Moreover, HCI research can lead to the development of new technologies and innovations that can improve various aspects of human life, such as healthcare, education, and entertainment [5].

II. BACKGROUND AND SIGNIFICANCE OF HCI

Human-Computer Interaction (HCI) is the study of how people interact with technology. This field has grown in importance in recent years, as technology has become an integral part of daily life for many people. From smartphones to laptops, technology is pervasive, and it has become increasingly important to understand how people interact with these devices to ensure that they are designed with user needs in mind.

HCI is a multidisciplinary field that draws on principles and methodologies from various areas, including computer science, psychology, design, and engineering. By combining these disciplines, researchers can gain insights into how people interact with technology and how technology can be designed to better meet user needs [6].

One of the key goals of HCI research is to develop user-friendly systems. This involves creating technology that is easy to use, efficient, and effective. By designing systems that are intuitive and user-friendly, researchers can improve user satisfaction and ensure that technology is more widely adopted.

HCI research is also critical in ensuring that technology is designed with accessibility in mind. This involves designing technology that is usable by people with disabilities, such as those with visual impairments or motor disabilities. By incorporating accessibility into the design process, researchers can create technology that is inclusive and ensures that all users can benefit from technology.

HCI is an important area of study that is growing in importance as technology continues to become more ubiquitous. Understanding how people interact with technology is critical in developing systems that are user-friendly and accessible. By incorporating principles and methodologies from various disciplines, HCI researchers can gain insights into how technology can be designed to better meet user needs, resulting in technology that is more effective and widely adopted [7].

III. METHODOLOGY IN HCI

a) *User-centered design:* User-centered design (UCD) is a design process that focuses on the needs and perspectives of users throughout the design process. Key principles of UCD include involving users in the design process through user research and testing, using iterative design cycles, and prioritizing ease of use and user satisfaction. UCD can be applied in various fields such as education, where it can be used to develop user-friendly learning management systems,

and healthcare, where it can be used to design medical devices that are easy to use for patients and healthcare providers [8].

b) *Usability testing*: Usability testing involves evaluating a system or product with real users to identify usability issues and improve user satisfaction. Key principles of usability testing include recruiting representative users, defining clear tasks for users to complete, and collecting both qualitative and quantitative data. Usability testing can be applied in various fields such as entertainment, where it can be used to test the usability of video games or virtual reality experiences, and education, where it can be used to evaluate the usability of e-learning platforms.

c) *Interaction design*: Interaction design involves designing the interface and interaction between users and technology. Key principles of interaction design include designing for the user's mental model, providing clear feedback and affordances, and designing for ease of use and learnability. Interaction design can be applied in various fields such as healthcare, where it can be used to design interfaces for medical devices that are easy to use for patients and healthcare providers, and entertainment, where it can be used to create immersive experiences that engage users.

d) *Cognitive psychology*: Cognitive psychology is the study of how people process information, learn, and remember. Key principles of cognitive psychology include understanding the user's mental model, attention, perception, and memory. Cognitive psychology can be applied in various fields such as education, where it can be used to design instructional materials that are optimized for the user's cognitive abilities, and healthcare, where it can be used to design medical devices that are easy to use for patients with cognitive impairments.

e) *Human factors engineering*: Human factors engineering involves designing systems that are optimized for human use and performance. Key principles of human factors engineering include considering human limitations and capabilities, designing for safety and usability, and conducting user-centered design and testing. Human factors engineering can be applied in various fields such as transportation, where it can be used to design interfaces for automobiles and airplanes that are easy to use and safe, and healthcare, where it can be used to design medical devices that are optimized for healthcare providers and patients.

f) *Information architecture*: Information architecture involves organizing and structuring information to make it easy to find and use. Key principles of information architecture include understanding the user's information needs, creating a clear and consistent structure, and using labels and metadata to help users find information. Information architecture can be applied in various fields such as e-commerce, where it can be used to design online shopping websites that are easy to navigate and find products, and healthcare, where it can be used to design electronic health records that are easy to search and access patient information.

IV. APPLICATIONS OF HCI IN EDUCATION

HCI has revolutionized the field of education by providing interactive and engaging ways of learning. Technology has enabled the creation of virtual classrooms, online courses, and e-books, making learning accessible to anyone with an internet connection. HCI has also helped to

develop educational games and simulations, providing an immersive learning experience for students. HCI has made significant contributions in the field of education, making learning more interactive, engaging, and accessible. The following are some applications of HCI in education [9].

The applications of HCI in education have been numerous and varied, providing students with interactive and engaging ways of learning. Virtual classrooms, online courses, educational games, and simulations are just a few examples of how HCI has transformed the traditional classroom experience, making education more accessible and enjoyable for students of all ages and skill levels.

a) *Virtual learning environments (VLEs)*: VLEs are online platforms that facilitate the delivery of educational content and the management of learning activities. VLEs typically include features such as discussion forums, chat rooms, and multimedia content. HCI is crucial in the design of VLEs, ensuring that they are user-friendly, accessible, and engaging for learners.

Virtual classrooms are an excellent example of how HCI has transformed the traditional classroom experience. These environments provide students with access to a range of learning materials, including videos, interactive presentations, and assessments. The use of HCI principles in virtual classrooms enables instructors to design interfaces that are intuitive and user-friendly, allowing students to navigate through the material with ease.

b) *Online courses*: HCI has enabled the creation of online courses, which are accessible to anyone with an internet connection. Online courses provide flexibility, allowing students to learn at their own pace and on their own schedule. HCI is critical in the design of online courses, ensuring that the content is presented in an engaging and interactive way.

Online courses are another way in which HCI has impacted education. These courses allow students to learn at their own pace and on their own schedule, making education more accessible to a broader range of people. HCI principles are used to design online courses that are engaging and interactive, providing students with a personalized learning experience that meets their needs and requirements [10].

c) *Educational games and simulations*: HCI has enabled the creation of educational games and simulations, providing an immersive learning experience for students. Games and simulations can make learning more engaging and enjoyable, motivating students to learn and providing a safe environment to practice new skills. HCI has also played a significant role in the development of educational games and simulations. These games and simulations are designed to provide an immersive learning experience, allowing students to engage with the material in a fun and interactive way. HCI principles are used to design interfaces that are easy to use and understand, making the games and simulations accessible to students of all ages and skill levels.

One example of educational games that have been developed through the application of HCI principles is MinecraftEdu. MinecraftEdu is an educational version of the popular game Minecraft, designed to teach students about various subjects such as history, math, and science. The game uses interactive and engaging interfaces to teach students about these subjects, providing them with a fun and exciting way to learn.

d) *simulations*: HCI has also played a significant role in the development of educational simulations. Simulations are used to teach students about complex systems and processes, such as the human body, weather patterns, and ecosystems. HCI principles are used to design interfaces that allow students to interact with the simulations, providing them with a hands-on learning experience.

One example of educational simulations that have been developed through the application of HCI principles is PhET Interactive Simulations. PhET Interactive Simulations is a website that provides a range of interactive simulations designed to teach students about various scientific concepts, including physics, chemistry, and biology. The simulations use intuitive interfaces that allow students to interact with the simulations, providing them with a better understanding of the concepts being taught.

e) *E-books*: HCI has enabled the creation of e-books, which provide an alternative to traditional textbooks. E-books can include interactive features, such as videos, animations, and quizzes, making learning more engaging and interactive.

f) *Mobile learning*: HCI has enabled the development of mobile learning, which allows learners to access educational content on their mobile devices. Mobile learning provides flexibility, allowing learners to learn on-the-go, and can be particularly useful for learners who do not have access to traditional educational resources [11].

g) *Accessibility*: Educational technology must be accessible to all learners, regardless of their abilities. HCI can ensure that educational technology is designed to be accessible and usable by all learners.

h) *Usability*: Educational technology must be designed to be user-friendly and easy to use. HCI can ensure that educational technology is designed with the needs and preferences of learners in mind.

i) *Engagement*: Educational technology must be designed to be engaging and interactive, motivating learners to learn and encouraging participation. HCI can ensure that educational technology is designed with engaging and interactive features.

j) *Feedback*: Educational technology must provide learners with feedback on their progress and performance. HCI can ensure that educational technology is designed to provide learners with meaningful and timely feedback.

k) *Personalization*: Educational technology must be designed to be personalized to the needs and preferences of learners. HCI can ensure that educational technology is designed to be adaptive and customizable to individual learner needs.

V. APPLICATION OF HCI IN ENTERTAINMENT

HCI has transformed the entertainment industry by enabling the creation of immersive and interactive experiences. Virtual and augmented reality technologies have enhanced the gaming experience, making it more realistic and engaging. HCI has also enabled the creation of interactive movies, allowing the audience to control the storyline and engage with the characters. HCI has had a significant impact on the entertainment industry, providing new ways to create and experience immersive and interactive content [12]. The following are some of the applications of HCI in entertainment:

a) *Virtual and augmented reality* - HCI has enabled the development of virtual and augmented reality technologies, providing new ways to experience games, movies, and other forms of entertainment. Virtual reality creates a fully immersive experience by transporting the user to a virtual world, while augmented reality enhances the real world by overlaying digital content on top of it. HCI is crucial in the design of virtual and augmented reality experiences, ensuring that they are engaging, intuitive, and accessible [12].

b) *Interactive movies* - HCI has enabled the creation of interactive movies, allowing the audience to control the storyline and engage with the characters. Interactive movies provide a unique and immersive experience, blurring the lines between traditional cinema and gaming. HCI is critical in the design of interactive movies, ensuring that they are easy to navigate, engaging, and provide meaningful interactions.

c) *Gamification* - HCI has enabled the application of gamification to various forms of entertainment, including education, fitness, and marketing. Gamification involves the use of game design principles and mechanics to motivate and engage users. HCI is essential in the design of gamified experiences, ensuring that they are enjoyable, challenging, and provide meaningful feedback.

d) *Social media* - HCI has played a significant role in the design and development of social media platforms, such as Facebook, Twitter, and Instagram. Social media platforms provide a new form of entertainment, enabling users to connect with others and consume and share content. HCI is crucial in the design of social media platforms, ensuring that they are easy to use, engaging, and provide meaningful interactions.

e) *Digital content creation* - HCI has enabled the creation of digital content, such as videos, animations, and music, providing new ways to entertain and engage audiences. Digital content creation tools, such as video editing software and digital audio workstations, rely on HCI principles to ensure that they are intuitive, accessible, and provide a seamless user experience [13].

f) *Usability* - Entertainment experiences must be designed to be user-friendly and easy to use. HCI can ensure that entertainment experiences are designed with the needs and preferences of users in mind.

g) *Engagement* - Entertainment experiences must be designed to be engaging and interactive, motivating users to participate and providing a sense of immersion. HCI can ensure that entertainment experiences are designed with engaging and interactive features.

h) *Accessibility* - Entertainment experiences must be accessible to all users, regardless of their abilities. HCI can ensure that entertainment experiences are designed to be accessible and usable by all users.

i) *Feedback* - Entertainment experiences must provide users with feedback on their progress and performance. HCI can ensure that entertainment experiences are designed to provide users with meaningful and timely feedback.

j) *Personalization* - Entertainment experiences must be designed to be personalized to the needs and preferences of users. HCI can ensure that entertainment experiences are designed to be adaptive and customizable to individual user needs.

HCI has transformed the entertainment industry, providing new ways to create and experience immersive and interactive content. From virtual and augmented reality to interactive movies and gamification, HCI has enabled the development of new and exciting entertainment experiences. By considering key HCI principles, entertainment experiences can be designed to be user-friendly, engaging, accessible, and personalized, providing a seamless and immersive user experience.

VI. APPLICATION OF HCI IN HEALTHCARE

HCI has had a significant impact on the healthcare industry by providing innovative ways of diagnosis and treatment. The use of wearable devices and mobile apps has enabled patients to monitor their health and receive personalized treatment. HCI has also enabled the development of telemedicine, providing remote access to medical services, and reducing the need for physical visits to the hospital. HCI has brought about many applications in healthcare that have improved patient care and outcomes [14]. The following are some examples of how HCI has been applied in healthcare:

a) Wearable devices and mobile apps: HCI has enabled the development of wearable devices, such as fitness trackers, smartwatches, and health monitors, which can track various health indicators such as heart rate, blood pressure, and activity levels. Mobile apps have also been developed to provide personalized health management and treatment plans. Patients can use these devices to monitor their health, receive alerts, and communicate with healthcare providers.

b) Electronic health records (EHRs): EHRs are digital versions of patients' medical records that can be accessed by healthcare providers. HCI has enabled the design of EHR systems that are user-friendly and accessible, allowing healthcare providers to access patient information quickly and easily.

c) Telemedicine: HCI has enabled the development of telemedicine, which allows patients to receive medical care remotely. Telemedicine services include virtual consultations, remote monitoring, and tele-surgery. Patients can connect with healthcare providers through video conferencing and receive medical advice and treatment without physically visiting the hospital.

d) Medical imaging: HCI has enabled the development of medical imaging technology, such as magnetic resonance imaging (MRI), computed tomography (CT), and ultrasound. These technologies have improved the accuracy of diagnosis and treatment planning, enabling healthcare providers to identify and treat medical conditions more effectively.

e) Patient education: HCI has enabled the development of interactive patient education materials, such as videos, animations, and interactive software. These materials can help patients better understand their medical condition, treatment options, and how to manage their health. HCI has played a critical role in the design and development of healthcare technology. The following are some key considerations for HCI in healthcare:

f) Usability: Healthcare technology must be designed to be user-friendly and easy to use. HCI can ensure that healthcare technology is designed with the needs and preferences of patients and healthcare providers in mind.

g) Accessibility: Healthcare technology must be accessible to all patients, regardless of their abilities. HCI can ensure that healthcare technology is designed to be accessible and usable by all patients.

h) Privacy and security: Healthcare technology must be designed to protect patient privacy and personal information. HCI can ensure that healthcare technology is designed to be secure and compliant with regulatory standards.

i) Engagement: Healthcare technology must be designed to be engaging and interactive, motivating patients to manage their health and participate in their treatment. HCI can ensure that healthcare technology is designed with engaging and interactive features.

j) Personalization: Healthcare technology must be designed to be personalized to the needs and preferences of patients. HCI can ensure that healthcare technology is designed to be adaptive and customizable to individual patient needs.

HCI has brought significant advancements to healthcare, improving patient care, and outcomes. The use of HCI in healthcare will continue to grow, with new technologies and applications being developed to further enhance the patient's experience.

VII. CASE STUDIES AND EXAMPLES

Case studies and examples are essential in showcasing how HCI principles and methodologies are applied in real-world situations [15]. Below are a few examples of case studies and research projects that have applied HCI concepts:

a) Mobile application usability testing: Usability testing is a key HCI methodology used in mobile application development. In a case study conducted by User Testing, a mobile application was tested to determine its usability and identify areas for improvement. The study found that by incorporating user feedback, the application's user experience was improved, resulting in increased user satisfaction and engagement.

b) Virtual reality in HCI research: Virtual reality (VR) is an emerging technology that is being used in HCI research to create immersive experiences for users [16]. In a study conducted by the University of California, researchers used VR to simulate a natural environment and study how users interact with their surroundings. The study found that by incorporating realistic sensory feedback, users were more engaged and immersed in the experience.

c) User-centered design in healthcare technology: HCI principles are critical in the design of healthcare technology that is easy to use for both patients and healthcare providers. In a case study conducted by the University of Michigan, researchers used user-centered design to develop a mobile application that helps patients manage their medication. The study found that by incorporating user feedback into the design process, the application was more effective in helping patients adhere to their medication regimen.

d) E-commerce website design patterns: HCI principles are crucial in the design of e-commerce websites that are user-friendly and engaging. In a study conducted by the University of Waterloo, researchers analyzed different design patterns used in e-commerce websites to

determine their effectiveness in improving user experience.

- e) The study found that by incorporating design patterns such as clear navigation, product recommendations, and user reviews, e-commerce websites were more effective in engaging users and increasing sales [16].

These case studies and examples demonstrate the importance of incorporating HCI principles and methodologies in technology design to create user-friendly, engaging, and effective systems.

VIII. CHALLENGES IN HCI TECHNOLOGY

HMIs essentially have no drawbacks. Any minor defects they have are outweighed by their usefulness [17]. These days, people value and use them greatly. Any interface problem could arise because of the following.

- 1) *Security*: Although HMI software systems have long been thought to be secure from infection, they now offer a high risk of hacking due to their connectivity to the internet. A deficient HMI could serve as a point of entry for hackers to crash systems, potentially resulting in the loss of crucial security and confidential data.
- 2) *Poor Interface Design*: The majority of machine and auto accidents are blamed on human mistakes, but when they are thoroughly investigated, it is frequently found that an HMI's poor design, which led to issues with operator-machine interface, was to blame. A badly designed interface may have undesirable operational effects and mistakes that could have a serious negative effect on performance and safety.
- 3) *Greater risk of human error in operation*: Even worse, technology that disregards the principles and best practices of effective human-computer interaction might raise the possibility of operational human error. Depending on the nature of the work being done, even a seemingly insignificant human error could have a significant influence on cost, safety, and other crucial aspects.

IX. CONCLUSION AND FUTURE SCOPE

In conclusion, Human-Computer Interaction is a vital field that plays a critical role in ensuring that technology is designed to meet the needs of users. Through various methodologies such as user-centered design, usability testing, interaction design, cognitive psychology, human factors engineering, and information architecture, HCI researchers and practitioners can create systems that are more efficient, effective, and user-friendly. By using this review paper, we understood that HCI is an essential area of study that has significant implications for the development of technology in various fields as technology continues to evolve, research in HCI will remain critical in ensuring that technology is designed to meet the needs of users.

In the future, HCI research is likely to focus on the development of emerging technologies such as virtual and augmented reality, artificial intelligence, and machine learning. There will also be a need to consider ethical, social, and cultural implications in HCI research, particularly in areas such as privacy, security, and accessibility. Moreover,

as technology becomes more integrated into everyday life, there will be a need to design systems that are more seamless and intuitive, and that can adapt to changing user needs and preferences.

REFERENCES

- [1] A. Oulasvirta, K. Hornbæk, A. Howes, E. Kurvinen, and G. Fitzpatrick, "Five HCI grand challenges," *ACM Transactions on Computer-Human Interaction (TOCHI)*, vol. 27, issue 2, pp. 1-36, 2020.
- [2] J. Zhang, W. Zou, J. Huang, and X. Cao, "Understanding user needs for personalized speech-based assistive technology in smart home environment," *International Journal of Human-Computer Studies*, vol. 125, pp. 1-12, 2019.
- [3] E. Luger, and A. Sellen, "Like having a really bad PA: the gulf between user expectation and experience of conversational agents," *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, pp. 5286-5297, 2016.
- [4] M. Beaudouin-Lafon, and W. Mackay, "HCI remixed: reflections on works that have influenced the HCI community. Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems, 3155-3162, 2016.
- [5] R. Xiao, H. Mi, and C. Tang, "Designing a virtual classroom platform for online education: a case study. Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing, pp. 1196-1208, 2017.
- [6] J. A. Fails, and D. R. Olsen Jr, "Interactive machine learning. *ACM Computing Surveys (CSUR)*," vol. 49, issue 1, pp. 1-45, 2016.
- [7] J. Li, and T. Wang, "Intelligent user interfaces: Evolution, state of the art and future trends. *International Journal of Human-Computer Studies*," vol. 122, pp. 38-56, 2019.
- [8] S. Kujala, T. Walsh, P. Nurkka, and L. Mäkelä, "Designing for self-reflection and personal growth: lessons from the design of a digital emotion diary. Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, 3027-3038, 2017.
- [9] A. Sonderegger, and J. Sauer, "The influence of user-generated content on traveler behavior: An empirical investigation on the effects of eWOM on hotel bookings," *Computers in Human Behavior*, vol. 86, pp. 75-85, 2018.
- [10] K. Oyibo, M. Byrne, and B. Smyth, "Beyond the stars: exploiting user-generated reviews to improve hotel ranking and selection. Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing," pp. 1449-1461, 2017.
- [11] M. A. Bhuiyan, M.M. Hassan, and A. Alamri, "Smart healthcare systems: a review of design and modeling methodologies. *Journal of Biomedical Informatics*, vol. 92, pp. 103139, 2019.
- [12] J. Teevan, M.R. Morris, S. F. Bush, and A. Patel, "The everyday lives of emoji: exploring emotional expression through avatars," *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, pp. 1-13, 2018.
- [13] W. S. Lasecki, C. Xia, and J.P. Bigham, "Real-time crowd labeling for voice-based interactive systems. Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems," pp. 1-14, 2018.
- [14] S. Rintel, and K. O'Hara, "The challenges of using emojis in digital communication," *International Journal of Human-Computer Studies*, vol. 109, pp. 22-30, 2017.
- [15] N. Jaiswal, V. K. Gupta, and A. Mishra, "Survey paper on various techniques of recognition and tracking," 2015 International Conference on Advances in Computer Engineering and Applications, Ghaziabad, India, pp. 921-925, 2015.
- [16] M. K. Singh, P. Singh, V. K. Gupta, K. Mishra, and A. Gupta, "Performance Analysis of CNN Models with Data Augmentation in Rice Diseases," 2023 3rd Asian Conference on Innovation in Technology (ASIANCON), Ravet IN, India, 2023, pp. 1-5, 2023.
- [17] S. K. Mishra, A. Gupta, A. Tomar and V. K. Gupta, "Health Care Prediction for Various Diseases using Computational Intelligence Approaches: A Review," 2023 World Conference on Communication and Computing (WCONF), RAIPUR, India, pp. 1-6, 2023.