

Artificial Intelligence for Human Computer Interaction: Systematic Literature Review

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Abstract

The application of artificial intelligence (AI) in human-computer interaction (HCI) has several challenges, such as data limitations, policies and regulations, digital divide, and language and cultural diversity. Therefore, the objectives in this study are to identify the latest developments in the development of AI for human-computer interaction, identify the challenges and opportunities in the use of AI in HCI, analyze the contribution of HCI in the development of AI and identify future research and development directions in the use of AI in HCI. The results of this study are Collaboration between HCI and AI is important to create intelligent and effective interfaces. HCI is applied in various fields such as healthcare, customer service, research, emotion recognition, robotics, vehicles, and wearable systems with the aim of improving human-computer interaction. Based on the findings, it can provide an overview of how future researchers to choose research topics in the field of applying Artificial Intelligence using the principles of Human and Computer Interaction.

Keywords: Human Computer Interaction; Artificial Intelligence; Systematic Literature Review;

INTRODUCTION

In the current era of technological development, many lines of life depend on equipment that uses computer technology. New technologies are constantly evolving, affecting the way individuals live their daily lives (Zotti & Neubauer, 2019). As society's demands for the use of technology increase, so does the focus on the human-computer interaction technology development sector as much as possible, allowing people to connect with technology and get support to help human work (Ademi, 2023).

The multidisciplinary subject of computer technology design known as "Human-Computer Interaction" (HCI) or human-computer interaction focuses on how people interact with computers (Armanda et al., 2022). Making it easier for humans to use computers and get appropriate feedback are the main goals of the idea of human-computer interaction (Hamidah et al., 2023). HCI is developed by combining several fields of science, including psychology, computer science, cognitive science, ergonomics, and human factors engineering (Suprato, 2021).

BACKGROUND

Human-computer interaction (HCI) research is usually divided into two categories: micro-HCI and macro-HCI. Micro-HCI researchers concentrate on creating innovative interfaces and generating standards for their applications on desktop, online, mobile or cellular devices, and wearable computers. The rapid advancement of technology that must be adapted for a wide variety of users such as beginner or advanced, young or elderly, illiterate or not, and disabled or not, it is a challenge to study the field of human and computer interaction. The development of interfaces in broader domains, such as emotional experience, aesthetics, motivation, social engagement, trust, empathy, responsibility, and privacy, presents difficulties for researchers in the macro-HCI field (Beny & Herti, 2020).

Artificial Intelligence (AI) is defined as the ability of a computer to perform cognitive functions related to the human mind, such as understanding, reasoning, learning, and solving (Arinez et al., 2020). Artificial Intelligence (AI) and Human-Computer Interaction (HCI) go hand in hand as technology develops. On the one hand, AI seeks to mimic humans and rationalize their behavior to build various types of intelligent systems, including robots. On the other hand, HCI seeks to understand humans to better adapt machines to improve safety, experience, efficiency and comfort. AI focuses on rational internal mechanisms. In contrast, HCI focuses on the interaction between humans and the tools they use (kolski et al., 2020). Artificial Intelligence (AI) has the potential to revolutionize the way humans interact with computers. The capacity of computers to recognize and understand human language, identify emotions, and offer context-related answers has improved significantly over the past few decades. However, much research and development is still needed to create the ideal AI for human-computer interaction.

Problems in applying AI using HCI principles include data limitations and biases, vagueness and trust, recognition and response errors, loss of user context, dependence on technology, data privacy and security, and lack of customization and personalization (Cui et al., 2023). The way to overcome these problems is that continuous research and development is needed, including improving data quality, increasing transparency, paying attention to ethics, and considering user needs and preferences (Lin et al., 2022). Therefore, this research aims to look at recent developments in AI for human-computer interaction, and to identify challenges and opportunities in this field. A better understanding of the potential and limitations of AI, it is hoped that more effective solutions can be developed to improve the user experience in interaction with computers.

FORMULATION OF RESEARCH QUESTIONS

The purpose of this study is to answer several Research Question (RQ) questions:

1. RQ1: What is Human Computer Interaction and Artificial Intelligence?
2. RQ2: What is the relationship between Human Computer Interaction and Artificial Intelligence?
3. RQ3: What is the application of Human Computer Interaction and Artificial Intelligence?

The researcher collected papers on artificial intelligence for human and computer interaction and defined into RQ1. Responding to RQ2 using the results of Q1 where Q2 is more likely to analyze the relationship between Human Computer Interaction and Artificial Intelligence. RQ3 is the last part which involves the application of Human Computer Interaction and Artificial Intelligence analyzed in the literature review.

RESEARCH OBJECTIVE

The objectives in this study are to identify the latest developments in the development of AI for human-computer interaction, identify the challenges and opportunities in the use of AI in HCI, analyze the contribution of HCI in the development of AI and identify future research and development directions in the use of AI in HCI.

RESEARCH METHODOLOGY

Literature study or literature review was used as the method of this research. This approach involves reading published books and research articles or journals to obtain information. Several journals discussing the research problem were consulted to obtain data, and the main points of the journals were then considered. The stages carried out in the literature review in this study are the stages of formulating research questions, searching for papers, selecting papers that meet the criteria, analyzing papers and drawing conclusions. The following Figure 1 explains the stages of the research conducted:

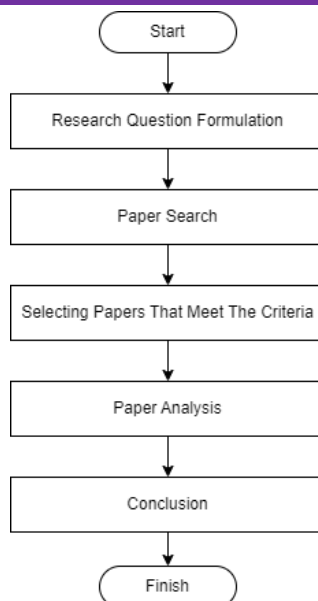


Figure 1: Research Stages

DATA ANALYSIS

Based on the search results conducted by the author, 147 papers related to human computer interaction and Artificial Intelligence were found. Then the selection is carried out by including paper criteria, in this study choosing to use 10 papers that match the criteria and can answer predetermined research questions, obtained from the library agreed on the research method along with the year range, then starting to map each research title to find out the research activities that occur. The research studied is related to artificial intelligence for human and computer interaction.

No	Paper	Review
1	A Systematic Review of Human Computer Interaction and Explainable Artificial Intelligence in Healthcare With Artificial Intelligence Techniques (Nazar et al., 2021).	The knowledge of Explainable Artificial Intelligence (XAI), the link between HCI and AI in healthcare, is covered in this study. Healthcare technology is in ever-increasing demand, and that demand is growing daily. To increase technology acceptability, ensure compliance, good ergonomics, and high-performance design for all users and contexts of usage, there are several obstacles and gaps that need to be minimized or filled. In the past, numerous applications—including natural user interfaces, child computer interaction, accessibility for individuals with impairments, and human factors for healthcare—have been employed to enhance HCI. However, there are usability concerns with the usage of technologies like robots, such as privacy, trust, safety, user attitudes, culture, robot morphology, and emotions. In addition to robotics, AI is being used in the healthcare industry. Neurology, cancer, and cardiology are the three most frequently treated disorders by AI. Healthcare practitioners may be able to provide more effective and efficient care with the help of AI.
2	Human-Computer Interaction in Customer Service : The Experience with AI Chatbots—A Systematic	One such technology that can offer automated customer care for businesses is artificial intelligence (AI) Conversational Agents (CA) or chatbots, which has been popular in recent years. When clients have favorable chatbot experiences, it is advantageous for businesses to use them. The numerous components of

No	Paper	Review
	Literature Review (Nicolescu & Tudorache, 2022).	the customer experience determine whether customers have favorable or negative impressions, attitudes, and feelings. Customers respond by expressing intentions and/or wants toward the technology itself (continuous usage of the chatbot and acceptance of chatbot recommendations) or towards the business (purchasing and recommending products). According to empirical studies, relevancy and problem-solving responses have the most influence when utilizing chatbots for customer support. These elements often provide positive customer satisfaction, a higher likelihood that users will keep using chatbots, product purchases, and product recommendations.
3	Using ChatGPT for Human-Computer Interaction Research :A Primer (Tabone & Winter, 2023).	Coding and categorizing huge amounts of text, such as questionnaire and interview replies, is a time-consuming process in qualitative data analysis study. Text data analysis is often criticized for being difficult to replicate. This study applies ChatGPT to three types of data: (1) text box questionnaire responses about augmented-reality interfaces for pedestrian vehicles; (2) interview data from a study in which participants acted as seasoned interface pedestrians in an immersive virtual simulator; and (3) hard-thought data of participants viewing original paintings and their replicas. By doing so, it determines whether ChatGPT can be used as a legitimate tool in human-computer interaction research. The ChatGPT API was tasked with producing scores or summaries of text sets using a hierarchical method. According to the findings, ChatGPT produces sentiment scores that are significantly connected. Additionally, because ChatGPT (2) automatically transcribes the interview findings, it can produce insightful summaries. In summary, ChatGPT is a useful tool for text data analysis in HCI research.
4	Sensors and Artificial Intelligence Methods and Algorithms for Human-Computer Intelligent Interaction: A Systematic Mapping Study (Sumak et al., 2021).	Advanced human-computer intelligent interaction (HCII) techniques, algorithms, and sensor technologies. Using sensor technologies such cameras, EEG, Kinect, wearable sensors, eye trackers, gyroscopes, and others, studies in the fields of HCII and IUI are primarily concentrated on the intelligent recognition of emotions, gestures, and facial expressions. Instantaneous and learning-based AI techniques and algorithms are most frequently used by researchers. The most popular algorithm for many sorts of recognition, including emotions, facial expressions, and gestures, is called a support vector machine (SVM). Convolutional Neural Network (CNN) is a deep learning method that is frequently used to develop solutions for emotion, face, and gesture detection.
5	MMATERIC : Multi-Task Learning and Multi-Fusion for AudioText Emotion Recognition in Conversation (Liang et al., 2023).	Accurately identifying emotions in speech facilitates different analyses in artificial intelligence, notably in human-computer interaction systems, and aids in understanding the speaker's intention. The majority of the earlier techniques, however, call for a greater capacity to monitor the various emotional states of each speaker in a dialog. The solution put out in this research is to use Multi-Task Learning and Multi-Fusion AudioText Emotion Recognition in Conversation

No	Paper	Review
		(MMATERIC) for emotion recognition in discussions in order to get around the issues. To distinguish the emotions of several speakers in a conversation, MMATERIC can be used to refer to and combine the advantages of two distinct tasks: emotion recognition in text and emotion recognition in speech.
6	An Emotional Model Based on Fuzzy Logic and Social Psychology for a Personal Assistant Robot (Matin et al., 2023).	The advancement of artificial intelligence and emotional computing in recent years has led to a considerable evolution in personal assistants and social robots. Attaining more natural and humanized interactions with these systems is currently the key issue. To accomplish this, social robotics must incorporate emotional modeling. In this paper, a social robot application of an emotional model whose development was overseen by psychologists is discussed. This dimensional model, which is based on social psychology, contains six dimensions and twelve emotions. Fuzzy logic has been used to specify how emotions are affected by input stimuli and by the robot's responses, respectively. The methodology suggested by this paper, which makes it simple to modify the personality of a robot created by a team of psychologists, is its most important contribution. Additionally, even without technical understanding, it enables experts in psychology to identify the principles that link inputs and outputs to emotions. This methodology was created and tested on a robot personal assistant. It has three input stimuli: battery level, ambient light level, and touch caress.
7	Impact of Gestures on In-Car Task's Driver Distraction (Cui et al., 2023).	The need for novel, artificial intelligence-based engagement techniques that improve cybersecurity is growing as in-vehicle information systems (IVIS) become more complicated. Due to its individualized intuition and distinctiveness, In-Air Gesture is a possible option that could improve the security of human-computer interaction. In-Air Gesture's effect on driver distraction while operating a vehicle, however, and the scarcity of skeleton-based In-Air Gesture identification techniques in IVIS, remain largely unexplored. This research creates a framework specifically made for IVIS that recognizes in-air gestures and categorizes them as static or dynamic in order to address these difficulties. The research developed an evaluation method to gauge the driver's state of concentration while driving using the cue model, which was evaluated on a sizable AUTSL dataset and used in an experiment comparing In-Air Gesture and tactile contact in a driving simulation scenario. Our research demonstrates that In-Air Gesture offers an engagement option for IVIS in a multi-purpose driving environment that is more effective and less distracting, dramatically enhancing driving performance by 65%.
8	Laser-Induced Graphene for Multifunctional and Intelligent Wearable Systems: For Health Care and Human-Computer Interaction (Cui et al., 2023).	Since its discovery in 2014, laser-induced graphene (LIG) has had a significant impact on the field of wearable technology thanks to its superior electrical and mechanical properties and the quick advancement of its device fabrication method. Newly created wearable gadgets based on LIG technology have also been developed in recent years, and they exhibit the

No	Paper	Review
		multifunction and intelligence traits. The two industries most crucial to the growth of LIGs, healthcare and human-computer interface (HCI), are the focus of this review.
9	Human-Computer Interaction with a Real-Time Speech Emotion Recognition with Ensembling Techniques 1D Convolution Neural Network and Attention (Alsabhan, 2023).	voice Emotion Recognition (SER) decodes voice signals to determine a speaker's emotional state. Human-computer interaction is a burgeoning field, and SER has recently gained greater attention. Any intelligent system with adequate computational power can train itself to recognize it as a result. Human speech is extremely varied, which makes it challenging to develop a single, accepted method for identifying covert emotions. This study attempts to address this problem by merging emotional information from many languages with the development of a more robust and useful model for understanding human emotions. The model was made using a two-step technique. Feature extraction takes place in the first step, while classification of the features is done in the second. Features include ZCR, RMSE, and well-known MFC coefficients. For classification, two suggested models—a 1D CNN coupled with LSTM and attention and a unique 2D CNN architecture—were adopted. The findings indicate that the 1D CNN with LSTM and attention is preferable to the 2D CNN. The model's accuracy is 96.72%, 97.13%, 96.72%, and 88.39% for the EMO-DB, SAVEE, ANAD, and BAVED datasets, respectively. The model outperforms other prior attempts on the same dataset, illuminating the applicability and effectiveness of understanding various emotions across various languages.
10	Light-FER : A Lightweight Facial Emotion Recognition System on Edge Devices (Pascual et al., 2022).	Modern advanced artificial intelligence (AI) applications depend on facial emotion recognition (FER) algorithms to improve human-computer interaction. When employed on edge devices with constrained memory and computing power, the majority of deep learning-based FER systems struggle with low accuracy and high resource requirements. This work suggests a lightweight FER system, dubbed Light-FER, to address these issues. Light-FER is derived from the Xception model via model compression. The Xception architecture first undergoes pruning during network training to eliminate less crucial connections. The model is also quantized to a half-precision format, which can drastically lessen the amount of memory it uses. Thirdly, different deep learning compilers that employ certain sophisticated optimization strategies are benchmarked in order to further increase the FER system's inference speed. Finally, Light-FER is developed on an NVIDIA Jetson Nano to experimentally illustrate the goal of the suggested system on an edge device.

Answering the question on RQ1 Human Computer Interaction is Human-Computer Interaction (HCI) is the study of human interaction with computers. The goal is to create intuitive and easy-to-use interfaces that allow users to interact with technology effectively. HCI involves research in human behavior, cognitive psychology, and interface design. By applying HCI principles, user experience can be improved in various contexts, such as product design, software development, and human-robot interaction. Artificial Intelligence is a field of computer science that enables machines to think and learn like humans. AI

involves techniques such as machine learning, neural networks, and natural language processing. AI is used in various applications such as speech recognition, data analysis, robotics, and business intelligence. The goal is to develop intelligent systems that can learn and adapt to the environment. AI has great potential to bring positive impacts in various fields of life.

In question RQ2 in this literature review, it was found that HCI and AI complement each other in improving the interaction between humans and computers. HCI focuses on intuitive interface design, while AI enables systems to learn and provide a better user experience. HCI helps AI with the understanding of user behavior, while AI improves the system's ability to recognize and respond to users. Their collaboration is important in creating intelligent and effective interfaces for users.

Answering question RQ3 Human-Computer Interaction (HCI) is applied in a variety of fields, including healthcare (Nazar et al., 2021), customer service (Nicolescu & Tudorache, 2022), research (Tabone & Winter, 2023), emotion recognition (Pascual et al., 2022), robotics (Matin et al., 2023), vehicles (Cui et al., 2023) and wearable systems (Cui et al., 2023). HCI is used to improve the interaction between humans and computers by incorporating artificial intelligence, pattern recognition, and emotion modeling techniques. In all these fields, HCI plays an important role in designing interfaces that are intuitive, responsive, and satisfying for users.

CONCLUSION

Human-Computer Interaction (HCI) is the study of human interaction with computers, with the goal of creating intuitive and easy-to-use interfaces that allow users to interact with technology effectively. The principles of HCI involve research into human behavior, cognitive psychology, and interface design. Artificial Intelligence (AI) is a field of computer science that enables machines to think and learn like humans, through techniques such as machine learning, neural networks, and natural language processing. AI is used in various applications and has great potential to have a positive impact in various areas of life. In the literature review, it was found that HCI and AI complement each other in improving the interaction between humans and computers. HCI focuses on intuitive interface design, while AI enables systems to learn and provide a better user experience. Their collaboration is important in creating intelligent and effective interfaces for users. HCI is applied in various fields such as healthcare, customer service, research, emotion recognition, robotics, vehicles, and wearable systems. In all these fields, HCI is used to improve human and computer interaction by combining artificial intelligence, pattern recognition, and emotion modeling techniques, and designing intuitive and responsive interfaces.

Further research can be conducted through a more in-depth search on other publication media such as Scopus and IEEE. HCI and AI should continue to push the boundaries in the development of more intuitive, responsive and adaptive interfaces. The combination of understanding human behavior, good design, and the application of AI can have a positive impact in improving the interaction between humans and computers and expanding the application of daily life technologies.

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