IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, January 2026
Impact Factor: 7.67

Improving Human-Computer Interaction via Spatial Computing and Augmented Reality

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Abstract: *Mixed and augmented reality rely on "interaction." Mixed reality applications include humans, computers, and their environment. This conversation is possible. Human-computer interaction approaches and tactics have been studied extensively in recent decades, but they must be rediscovered in immersive environments. The Internet of Things and 5G GSM network provide advanced input techniques and computer environmental awareness. Other examples include sensors, processing power, and new technologies. Omnipresent sensors with a fast GSM network might improve mobile users' interactions with real or virtual objects. As technology advances, researchers may employ multimodal, tangible, and collaborative encounters.*

Keywords: Improving Human-Computer Interaction, Augmented Reality, Enhancing and human-computer interaction.

I. INTRODUCTION

The emphasis of human-computer interaction (HCI) has been on practical and fundamental research to improve end-user experience in AR/MR settings. The capacity of the user to carry out tasks and interact with the virtual environment using a variety of features and control methods is emphasized in the research. User comprehension is emphasized by user-centered system design (UCSD), which was first portrayed by Kling and then by Norman.

It investigates user presumptions and how to complete tasks or recover from errors, illustrating HCI as human-machine communication and collaboration. Investigating immersive worlds and the UCSD changed how people understand history and culture and do out everyday tasks. Our everyday lives are increasingly including mixed and augmented reality. Historical achievements in engineering, social networking, navigation, entertainment, and remote cooperation demonstrate AR & MR's bright future.Interactive representations of hitherto unexplored virtual and real-world pairings are made possible by technological advancements in AR and MR.

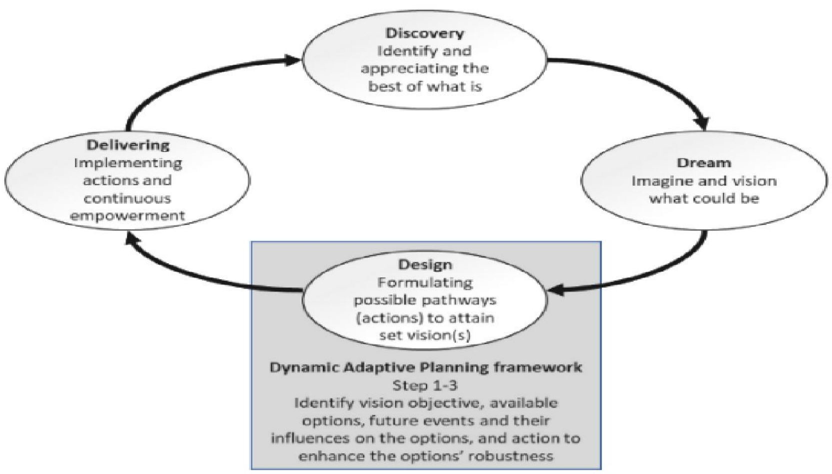

Fig 1: Content and technological route framework research

MR presented paired goods with virtual partners as genuine. MR ecosystems differ from AR by delivering mixed objects and geographic modalities, emphasizing spatial awareness and mindfulness. Distributed exploration and executions have shaped how individuals see future, hypothetical, and verified reality situations since the reality--virtuality continuum began. The latest interaction strategy evaluation and survey paper enhancements are not well organized, creating false impressions and ambiguity.

A unimodal system would come from merging haptic, taste, and smell approaches with sensor-based techniques.

Hit and Quek say humans communicate with the world via their senses. Therefore, analyzing AR and MR HCI in light of this discovery may stimulate novel interactions and innovative thinking. Agreements frequently concentrate on the field of use (travel, engineering, clinical), the device (portable, work area), or umbrella terms (multimodal, substantial, cooperative) rather than the manner or environment of contact. Thus, misrepresenting interaction approaches may annoy prospective HCI specialists and hamper their efforts. Past efforts to classify HCI components for mixed and augmented reality show that conventional academics lack a complete knowledge of such interactions.

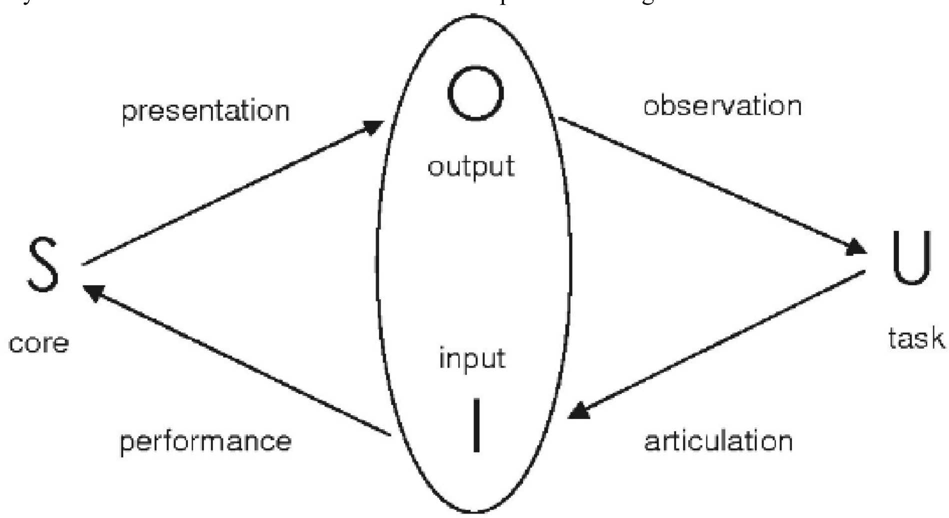

Fig 2: Human-computer interaction framework

Innovative ideas and applications may define new forms of interaction in mixed reality. In Norman's book The Design of Ordinary Things, HCI is linked to activity, correspondence, modalities, and discerning hypotheses. It's interesting that the sensor-based technique groups haptic with taste and smell, even though modalities may place haptic near to hear-able and visual. All of the scientific categorization presented here is an overview and an early attempt to reveal each approach and its most fundamental connections.

We expect our scientific classification to define the work done thus far, establish name conventions, and better organize continuing interaction approaches. Pamparau and Vatavu highlighted local UX and HCI issues in AR and MR environments in a recent position paper. One difficulty was creating interaction UX design data. This requires a clear order structure and interaction concerns that test UX. We found three main issues while dealing with vivid situations.

Humans must initially interact naturally with machines to perform selection, manipulation, navigation, and system control. Second, positional precision limitations of current technology in hybrid situations may cause spatial misalignments or dislocations. This should be avoided by making the interaction technique as natural as possible. Visualizing an MR environment requires correct end-user location estimation, which causes coverage-related technical problems.

For interactions to be "real" there must be a semantic context link between relevant realities. This review provides a characterized portrayal as part of a methodology-based and interaction-situated chart of the evaluated work, breaking down HCI research for vivid real factors and versatile settings and summarizing what has been done so far. The above informs the analysis. We offer a new way to categorize human-computer interaction (HCI) in immersive settings by connecting four modalities—auditory, visual, haptic, and sensor—and associated techniques.

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This study's main objective is to classify the different interaction strategies in a clear, organized manner to give more depth and accuracy on modalities' use, including how, when, and how. This original characterization model is the result of a strategic examination of the best way to coordinate classes to introduce the methodologies used in the reviewed papers in a predictable, exact, and significant way. Significant research is also thoroughly examined.

II. LITERATURE REVIEW

Li and Green (2023) examine spatial computing to improve immersive HCI. The research prioritizes spatial computing technology to provide clients a more dynamic and engaging experience. Spatial computing's applications, problems, and user experiences are examined to determine how it affects HCI. This study provides the groundwork for understanding how spatial computing will affect immersive HCI in the future and provides fresh insights into the technology's evolution.

Smith, Chen (2022) The article discusses augmented reality technology and HCI, including notable advancements, problems, and upcoming trends. The authors discuss how augmented reality is affecting user experiences, interaction paradigms, and interactive system design. This assessment makes augmented reality in HCI simple to understand and identifies opportunities for additional research and innovation.

Kim and Park (2024) research educational spatial computing and augmented reality. The study examines how these technologies may improve education by generating dynamic and immersive learning environments. The writers emphasize the They demonstrate the pros and cons of spatial computing in education by studying distinct use cases and implementations. This research adds to the literature by revealing how education, augmented reality, and spatial computing affect learning environments.

Space computing interface design was carefully investigated by Nguyen and Jones (2023). They learned about interface design's problems and prospects via their case study research. The authors stressed user-centered design and provided developers ideas on improving augmented reality navigation.

Wang and colleagues (2023) examined spatial computing and AR. The study examined many user connection and enjoyment techniques. We found that spatial computing increased user engagement. We learn how to employ spatial computing to make mobile user experiences more engaging and immersive from this study. Zhang and Li (2022) examined healthcare applications of augmented reality and spatial computing. Current technologies and their influence on medical systems were covered in the article. The authors noted possible benefits such surgical precision and medical education, as well as future obstacles and possibilities. This study helps explain healthcare spatial computing.

Spatial computing affected augmented reality game players' experiences, according to Garcia and Lee (2024). The study examined how spatial computing in game settings affects user enjoyment and immersion. The findings highlighted how spatial computing may improve game realism and engagement. This work adds to the expanding corpus of research on spatial computing and distraction, particularly in augmented reality gaming.

Spatial Computing In Xr

The term "Extended Reality" (XR) encompasses augmented reality (AR), virtual reality (VR), and mixed reality (MR), all of which provide consumers with immersive and interactive digital experiences. XR technologies have drastically changed how we engage with the digital and real worlds. Spatial computing is the fusion of many technologies, including computer vision, augmented reality, mixed reality, virtual reality, and enhanced sensors, to create a realistic and immersive digital world. This enhances XR and makes it possible for richer, more intuitive, and natural user experiences. Because virtual items and digital information are mapped onto real-world settings, users may see, interact with, and modify digital material as if it were physically there.

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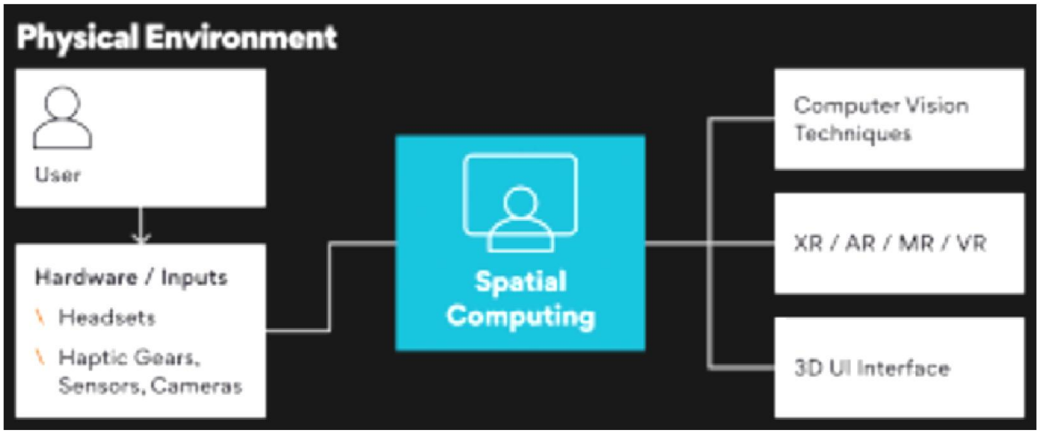

Fig 3: In Xr, Spatial Computing

Pioneers of HCI

The field of HCI has been strongly impacted by a small group of visionaries who envisioned novel approaches to using computers. They are not to be regarded as lone prophets. Their work was well recognized by other researchers and greatly influenced computer interface techniques used today. Give a useful historical overview of HCI.

The future of HCI

Global conferences are more relevant than rational journals in the rapidly evolving area of human-computer interaction. The ACM CHI Meeting is the largest and most established event in the area, with an acknowledgment rate of around 20% and a very severe degree of selection. One of the research even received a Best Paper Good Notice Grant, which is awarded to just the top 5% of distributions.

Three of the articles address specific problems with augmented and virtual reality, such as input inaccuracy, drawing constraint input, and the potential for augmented reality technology to enhance 3D printing. Future developments in spatial computing, such as VR protective hats and smart glasses, probably won't stop us from using our phones, just as the mobile phone didn't make the PC useless.

However, they will provide more administrations and new opportunities, which we are now pursuing.Future autonomous driving systems will also take into account these particular populations, as the Good Referenced Grant winning assessment, for example, looked at ways to establish connections between cars and vulnerable street users, such as the blind. In several first steps, the experts used virtual reality (VR) to investigate these anticipated outcomes.

Interacting with Computers

The study of human-computer interaction (HCI) focuses on how people communicate with and use computers. It developed from research on ergonomics (a term used in Europe) and human factors (a phrase used in the United States) with the practical goals of creating more dependable and useable computer systems and the intellectual goal of assessing tasks that people undertake with computers.

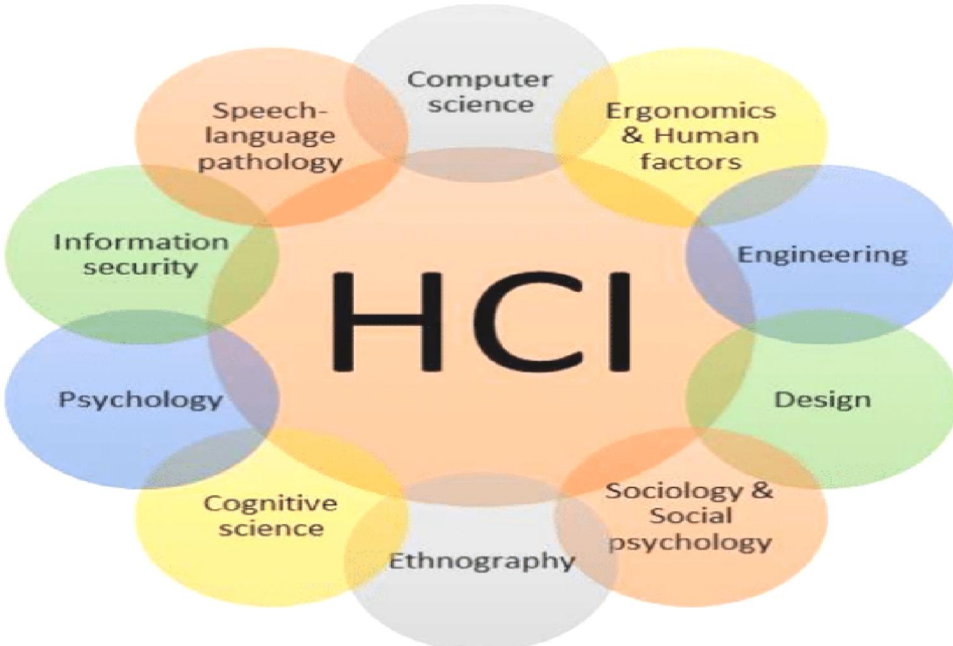

Fig 4: Human-computer interaction

As computers have become increasingly common in homes and workplaces, the area of human-computer interaction (HCI) has grown to include the cognitive, social, and organizational aspects of computer usage. HCI may provide techniques for modeling human-computer interactions, software development standards, ways to assess the usability of different computer systems, and ways to look into the effects of incorporating new technology into companies. This chapter covers a variety of topics, including the history of human-computer interaction (HCI), computer interaction, computer-mediated communication, computer use psychology, models of HCI, computer system design and evaluation, and the organizational and social aspects of computer usage.

III. CONCLUSION

Augmented reality (AR) and spatial computing together have the potential to revolutionize human-computer interaction (HCI). Spatial computing provides a more natural and immersive user experience by seamlessly merging the digital and physical worlds, while augmented reality (AR) overlays contextual information on the real environment. This confluence creates natural interactions and new avenues for cooperation in a variety of fields, including navigation, healthcare, and education. Despite some challenges, like privacy issues and technological constraints, the continued development and integration of these technologies portends a promising future that will transform our perceptions of, engagement with, and use of the digital realm in our daily lives.

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