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The Role of Expectations in Human-Computer Interaction Using by TOPSIS Method

Janaki Ram Kiran Gummaluri*

[*] *Senior Principal Data Services, Mr Cooper, TX, USA*

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ABSTRACT

Human-Computer Interaction

Human-Computer Interaction (HCI) refers to a multidisciplinary domain that involves creating, assessing, and implementing interactive computing systems. In an introductory context, HCI covers fundamental principles and concepts pivotal to the field. This foundational knowledge paves the way for delving into more complex subjects like interface design, usability testing, and user research. Given the continuous technological advancements, HCI remains a dynamic and crucial area of study in the digital era, offering exciting prospects for further exploration. Improved User Experiences: By studying user behaviors and preferences, researchers can identify pain points and design solutions that lead to more enjoyable and productive experiences with technology. Increased Technology Adoption: When technology is user-friendly and easy to use, people are more likely to adopt and integrate it into their daily lives. HCI research helps in reducing barriers to technology adoption, leading to broader acceptance and usage of various technological innovations.

Foster Innovation: Understanding human needs and behaviors in relation to technology inspires innovation. HCI research uncovers new insights into user requirements, enabling the development of novel technologies and applications that cater to diverse needs and preferences. Address Ethical Considerations: HCI research includes ethical considerations in the design process. It helps identify and mitigate potential risks related to privacy, security, and other ethical concerns, ensuring that technology is developed responsibly and with user well-being in mind. he prioritization of the ideal solution using the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is a multi-criteria decision-making method.

TOPSIS, also known as PIS (Positive Ideal Solution), is a technique that aims to identify the alternative with the shortest geometric distance from the positive ideal solution, while also ensuring a substantial distance from the negative ideal solution (NIS) in terms of geometry. The underlying decrease consistently. In many cases, scaling problems or criteria may have improper dimensions, making normalizations essential for meaningful comparisons. Text only, Text, voice, and image, Text, voice, and animation, Contingent face-to-face Competence, Dominance, Iron and steel, Sociability, Task-partner attraction, From the result it is seen that Competence is got the first rank where as is the Iron and steel is having the lowest rank.

*Corresponding author. Tel.: +1 (724) 732-2917; e-mail: gummalurijanakiramkiran@gmail.com

Introduction

Recently, the Turing robot team introduced Turing OS, an advanced AI robot operating system that supports multimodal interaction. By incorporating various input and output methods like text, voice, actions, and environmental cues, Turing OS enables robots to engage in human-like interactions. A notable example of a previous effort in this direction was IBM's collaboration with Soft Bank in 2016 to create Pepper, an emotionally responsive robot capable of understanding certain aspects of spoken language in specific contexts. Furthermore, Baidu's ABC Robot is a prominent platform for multi-modal human-computer interaction, offering features like speech recognition, semantic understanding, face recognition, gesture recognition, and multi-sensor fusion. The human-computer interface is a critical element in the design of human-machine systems. [1] Its primary purpose is to facilitate effective communication and interaction between users and machines, enabling users to operate the machines and establish a mutual platform for information exchange.

The design of the interface involves determining suitable input and output methods to ensure smooth human-computer interaction and achieve optimal functionality. This approach not only reduces cognitive load for users but also enhances their perception and operational capabilities. From the users' perspective, the interface is essentially the system itself. [2] The article explores the connection between underscoring the potential benefits arising from their integration. It furnishes a succinct definition of NLP in the context of HCI. In a historical context, the article traces the journey of NLP, encompassing significant advancements, setbacks, and key moments such as the emergence of machine translation, the influence of the ALPAC report, and the three pivotal phases in the field's evolution. The article delves into the various domains where NLP plays a vital role, citing examples of its application in research and practical systems within those domains. Regarding linguistic modeling, the article covers essential methodologies employed, including symbolic, stochastic, connectionist, and hybrid approaches.

To enhance comprehension, the article endeavors to categorize NLP systems in HCI based on the depth of linguistic analysis, supplemented by relevant examples of research and development efforts in each category. [3] Due to these factors, relied on punched cards and was limited to experts. However, it has since evolved into the graphical interface paradigm, which enables direct manipulation of visual elements like icons and windows using a pointing device. Despite significant advancements with the introduction of keyboards and mice, there are still scenarios where when interacting with three-dimensional (3D) objects. The mouse, with its two degrees of freedom, cannot effectively replicate the three-dimensional spatial dimensions. [4] We consider the integration of multiple disciplines as a crucial aspect Despite the worldwide professional organizations associated with HCI having a membership exceeding 10,000 individuals, including academics, researchers, and practitioners, only a small fraction of them possess formal degrees in HCI. The scarcity of such degrees can be attributed to the limited number of universities offering specialized programs in HCI. This scarcity is primarily due to the challenges involved in precisely defining the various components of HCI as a multidisciplinary field rather than a lack of interest. Researchers and practitioners in this field come from diverse backgrounds, encompassing behavioral sciences such as psychology, anthropology, and sociology, as well as computer science and other scientific and engineering disciplines. [5] Passive brain-computer interfaces (BCIs) complement other forms of Human-Machine Interaction by not interfering with them, unlike active or reactive BCIs. This is due to the nature of passive BCIs, as mentioned earlier. Passive brain-computer interfaces (BCIs) their interaction with conventional Human-Computer Interaction (HCI): those that rely on ongoing HCI and those that remain unaffected by it. Composability is a key advantage of passive BCIs, as multiple detectors can be used simultaneously in an application without conflicts. This is more challenging with active and reactive BCIs, as the user's conscious interaction with them is limited.

Moreover, passive BCIs offer cost benefits since they require no conscious effort apart from preparation, with operational costs primarily determined by prediction accuracy. These BCIs provide probabilistic estimates, allowing for cost-optimal decision making at the application level. In the worst-case scenario, there is no added benefit, making cost optimization arbitrary [6]. Research findings indicate that when individuals were not using a mouse, their response time to tactile stimuli with accompanying sounds near their hand was shorter compared to sounds farther away. However, when individuals were holding or actively using a mouse, there was no significant difference in response times between near and far sounds. Bassolino and their team interpret this as the mouse extending an individual's personal space. It's important to note that their study focused on the familiarity of the tool (the mouse) and did not directly investigate the real-world interaction between humans and computers concerning tool extension [7].

Over the past twenty years, the study of how personality factors impact human-computer interaction has gained significant attention. However, this research area lacks a specific disciplinary focus, and relevant publications can be found in various disciplines and journals. Personality factors not only influence human-computer interaction at the task level, such as programming, but also affect individuals' inclination to use computers for task completion. Furthermore, personality factors can even influence an individual's attraction towards pursuing a career related to computers. [8] Optimizing the human-computer interaction process is highly important, and it can be achieved by employing appropriate calculation methods. To enhance the efficiency of general sEMG signal equipment during human-computer interaction and simplify data processing, it is crucial to address the interference caused by in this study, a novel approach using variance theory is proposed for determining redundant electrodes in gesture recognition involving thumb-generated sEMG signals. [10] While the core ideas remain intact, the aesthetic shift encompasses more than merely modifying existing research topics. It can be contended that aesthetics is frequently employed to validate specific agendas and emphasize non-utilitarian aspects of interaction. Nonetheless, delving deeper into the examination of non-functional elements in Human-computer interaction plays a vital role in revitalizing the progress of digital technologies by providing a new, discerning, and inventive foundation [11].

Although specific details about the advancement of empirical studies in various aspects of human-computer interaction, such as were not located, I can propose an approach to investigate the development of techniques, models, and theories within these domains. One approach is to examine academic literature and research papers published over time in these fields. By reviewing studies conducted at different points in history, you can gain insights into how techniques, models, and theories have developed and evolved. Additionally, looking at influential papers and seminal works in these areas can provide a foundation for understanding the progression of research. [12] Psychological research often relies on data from participants who simulate emotional states. In such cases, there may be a relatively straightforward connection between acoustic variables and emotions, although there are still differences due to individual variation in expressiveness, personality, and mood. However, in everyday human-computer interactions, emotions tend to be more spontaneous.

Consequently, the variations in these situations are much greater, as the emotions experienced are often not prototypical but rather nuanced, blended, or weak, making them challenging to distinguish. [13] Specifically, the focus is on exploring the critical aspects of human-computer interaction (HCI) that play a crucial role in mobile computing. The paper also aims to propose potential solutions for designing and implementing effective HCI in this context. These considerations encompass a range of factors, including how computers are used and in what context, human characteristics, computer systems and interface architecture, and the development process. By delving into the challenges and situations faced by mobile workers and identifying available resources to address these issues, the paper aims to provide valuable insights. This information can be beneficial for business managers who are considering incorporating computing technologies into their mobile workforce.

Additionally, developers and designers working on future mobile computing products can use the research findings to better meet the needs of users in this domain. [14] This paper focuses on the technology and tools necessary to create innovative computer interfaces that can effectively handle nonverbal information, enabling the interface to adapt itself and enhance human-computer interaction (HCI). By utilizing diagnoses and predictions, the interface can simplify, highlight, or even provide tutoring to improve the overall HCI experience. This specialized form of communication aims to explore the internal The development of these novel computer interfaces is crucial for effectively processing and utilizing nonverbal information. [17] Designing attention-aware systems faces a significant challenge in terms of understanding the cognitive and perceptual processes that govern attention allocation. At a broader level, various theories with diverse hypotheses explain different aspects of attention, but there is no comprehensive framework that encompasses all attentional phenomena. On a more detailed level, research findings often focus on simple tasks and controlled environments that don't fully represent real-world user conditions, although they do provide reliable experimental settings. Unfortunately, this situation is unlikely to change in the near future.

Developing a unified theory that integrates different attentional aspects and can accurately describe individual phenomena while predicting their effects and interactions remains beyond our current capabilities. [21] A virtual moment refers to a communication process that incorporates technology to some extent. Minimal virtual moments can be seen in activities like telephone conversations and voice mail, where technology is used but human interaction is still prominent. On the other hand, human-computer interaction (HCI) represents a maximum level of technological involvement in virtual moments. Regardless of the level of technological presence, the defining characteristic of all virtual moments is that they remove certain elements of the human experience from a transaction. Virtual moments commonly occur when participants are physically separated in both time and space, allowing for interactions that require less emotional and intellectual investment. [24]

Materials & methods

Alternative: Text only, Text, voice, and image, Text, voice, and animation, Contingent face-to-face

Evaluation preference: Competence, Dominance, Sociability, Task-partner attraction

Text only: Text-only explanations can be found in various forms, such as articles, manuals, textbooks, blog posts, online forums, or even instant messaging conversations. They are commonly used in educational settings, technical documentation, troubleshooting guides, and online resources to communicate information effectively. When providing text-only explanations, it is essential to ensure clarity, coherence, and conciseness. The use of proper grammar, punctuation, and formatting techniques can enhance readability and understanding. Additionally, breaking down complex ideas into smaller, digestible parts and organizing the information logically can make text-only explanations more accessible and user-friendly.

Text, voice, and image: Text: Text refers to written or printed words, characters, or symbols that convey information or messages.

Voice: Voice refers to the sound produced by humans when speaking or the ability to express oneself through speech. In the context of technology, voice can also refer to voice-based communication or voice recordings.

Image: An image is a visual representation or depiction of an object, scene, or concept. It can be a photograph, a painting, a digital graphic, or any visual content that conveys information or expresses ideas. Images are composed of pixels and can capture a wide range of details, colors, textures, and shapes.

Text, voice, and animation: Text: Text is a written form of communication that utilizes written words, characters, and symbols to convey information. It is the most basic and widely used method of communication in written documents, books, articles, emails, messaging apps, and websites.

Voice: Voice communication involves the use of spoken words and sound to convey messages and information. It relies on the human voice to transmit ideas, emotions, and intent.

Animation: Animation is the technique of creating the illusion of movement through a sequence of images or frames. Animations can be used to entertain, educate, or convey information in various formats, including movies, TV shows, video games, advertisements, and online content.

Competence: Competence refers to the ability, skill, or knowledge that someone possesses in a particular area or task. It is the capability to perform effectively and efficiently, producing desired results or outcomes. Competence can be developed through education, training, experience, and practice. Competence is not static but can be developed and improved over time. It requires continuous learning, updating knowledge and skills, and adapting to new challenges and technologies. Organizations often assess competence through performance evaluations, skills assessments, and competency frameworks to ensure that individuals possess the necessary abilities to fulfill their roles effectively.

Dominance: Dominance, in the context of human behavior and social relationships, refers to the exertion of power, control, or influence over others. It is a concept often discussed in the fields of psychology, sociology, and animal behavior. Dominance can manifest in various forms, such as physical strength, social status, wealth, intelligence, or assertiveness. People who are dominant tend to assert themselves confidently and display behaviors that allow them to establish and maintain control or influence in social interactions or group dynamics. One-way dominance is expressed is through social hierarchies or pecking orders, where individuals within a group or society are ranked based on their dominance status. In such hierarchies, dominant individuals typically have preferential access to resources, opportunities, and mates, while subordinate individuals may have limited access. It plays a significant role in shaping social structures and relationships within these species. While dominance can be a natural and adaptive aspect of social behavior, it is important to note that excessive or abusive dominance can lead to negative consequences. It can contribute to inequality, oppression, and the suppression of others' rights or well-being. It is essential to strike a balance between assertiveness and respect for others in order to maintain healthy and mutually beneficial relationships.

Sociability: Sociability refers to the degree to which individuals seek and enjoy social interactions and relationships. While sociability is generally considered a positive attribute, it's important to note that individuals may vary in their sociability preferences. Some people may be more introverted and prefer fewer social interactions, while others may be more extroverted and seek frequent social engagement. Both ends of the spectrum are normal and valid expressions of sociability, as long as they align with an individual's needs and preferences.

Task-partner attraction: Task-partner attraction refers to the process by which individuals are drawn to or seek out specific individuals to collaborate with on a particular task or project. It is the tendency to feel a sense of connection, compatibility, or affinity towards someone as a potential partner for completing a task together. Overall, task-partner attraction involves a combination of factors such as complementary skills, shared goals, trust, interpersonal compatibility, previous successful collaborations, work preferences, and diversity. When individuals find someone who possesses these desirable qualities, they are more likely to feel attracted to them as potential partners for a task or project.

TOPSIS Method: TOPSIS, the Technique for Order Preference by Similarity to Ideal Solution, is a valuable multi-criteria decision-making technique that assesses and ranks is widely used in diverse fields like engineering, management, and environmental sciences to tackle complex decision-making problems involving multiple criteria. To treat all criteria equally, it is common to normalize the values in the decision matrix. Depending on the situation, some criteria may carry more importance than others. You can assign weights to each criterion to reflect their relative significance in the decision-making process. The ideal solution represents the best possible performance for each criterion, while the negative ideal solution represents the worst possible performance. For maximization criteria, the ideal solution is the highest value, while for minimization criteria, it is the lowest value.

Compute the Euclidean distance between each alternative and both the ideal solution and the negative ideal solution. This distance reflects the overall similarity or proximity of each alternative to the ideal solutions for all criteria. Compare the distances of each alternative to the ideal and negative ideal solutions. The closer an alternative is to the ideal solution and the farther it is from the negative ideal solution, the higher its relative closeness value will be. Finally, rank the alternatives based on their relative closeness values. The alternative with the highest relative closeness score is considered the best choice. TOPSIS provides a straightforward and effective approach to decision-making when dealing with multiple criteria and the need to consider both the advantages and disadvantages of each alternative. However, it is crucial to carefully select the criteria and their weights and ensure that the normalization process is appropriate for the specific problem under consideration.

Result and discussion

Table 1. TOPSIS of Human-Computer Interaction

DATA SET				
	Text only	Text, voice, and image	Text, voice, and animation	Contingent face-to-face
Competence	23.05	39.53	29.15	21.05
Dominance	29.12	35.44	30.69	27.3
Iron and steel	24.08	22.58	30.25	23.1
Dominance	23.17	28.28	24.6	30.15
Task-partner attraction	32.44	25.15	35.12	19.89

Table 1 shows the Alternative: Text only, Text, voice, and image, Text, voice, and animation, Contingent face-to-face Evaluation preference: Competence, Dominance, Iron and steel, Sociability, Task-partner attraction.

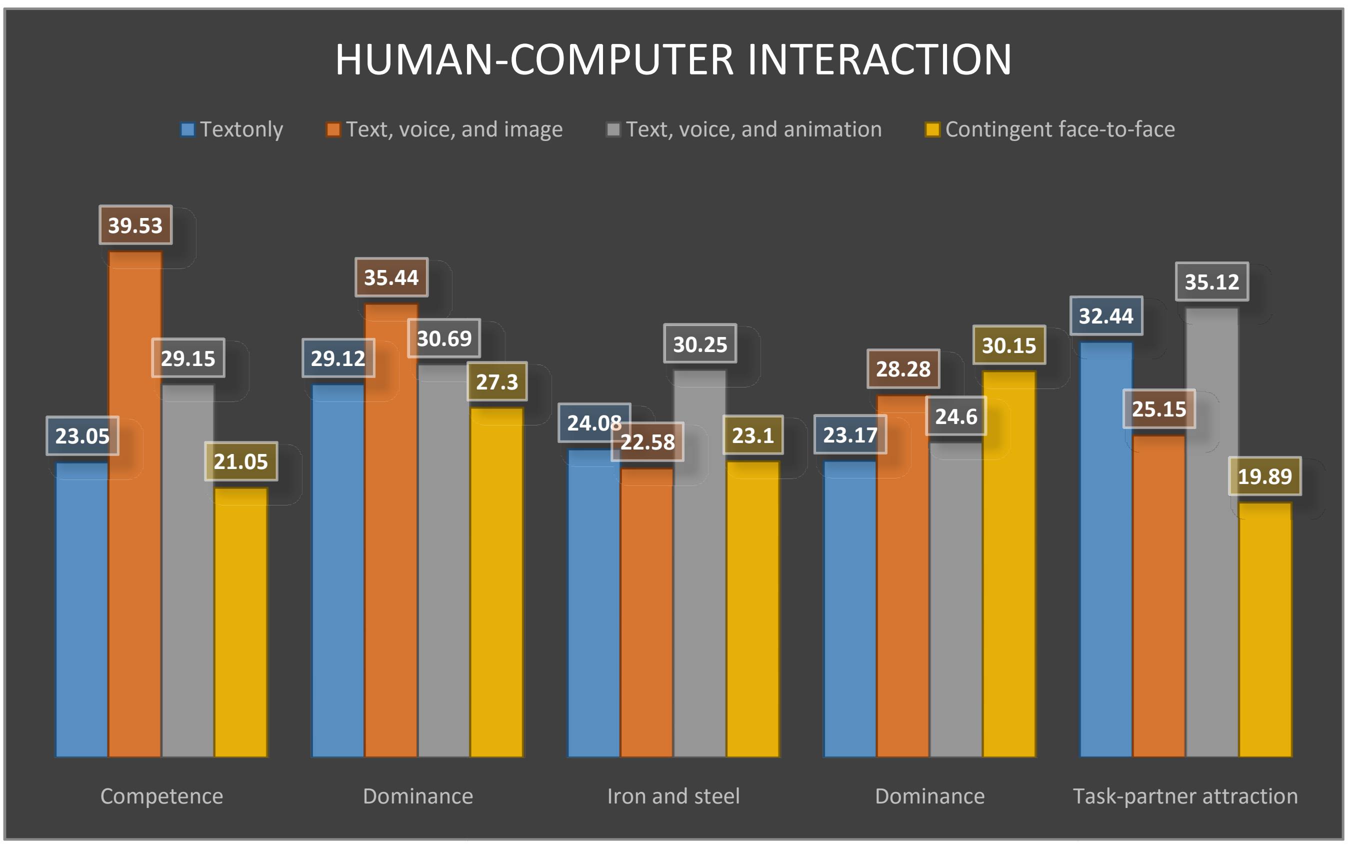

Figure 1. TOPSIS of agricultural soils

Figure 1 Shows the Alternative: Text only, Text, voice, and image, Text, voice, and animation, Contingent face-to-face Evaluation preference: Competence, Dominance, Sociability, Task-partner attraction.

Table 2. Squire Rote of matrix

531.3025	1562.621	849.7225	443.1025
847.9744	1255.994	941.8761	745.29
579.8464	509.8564	915.0625	533.61
536.8489	799.7584	605.16	909.0225
1052.354	632.5225	1233.4144	395.6121

Table 2 shows the Squire Rote of matrix value.

Table 3. Normalized Data

Normalized Data			
Text only	Text, voice, and image	Text, voice, and animation	Contingent face-to-face
0.386954	0.663613	0.4323748	0.382624
0.488855	0.594952	0.4552172	0.496229
0.404245	0.379064	0.4486908	0.419886
0.388968	0.474753	0.3648858	0.548034
0.544589	0.422208	0.5209263	0.361539

Table 3 Normalized Data shows the informational set for the Alternative: Text only, Text, voice, and image, Text, voice, and animation, Contingent face-to-face Evaluation preference: Competence, Dominance, Sociability, Task-partner attraction. The Normalized data is calculated from the data set value is divided by the sum of the square root of the column value.

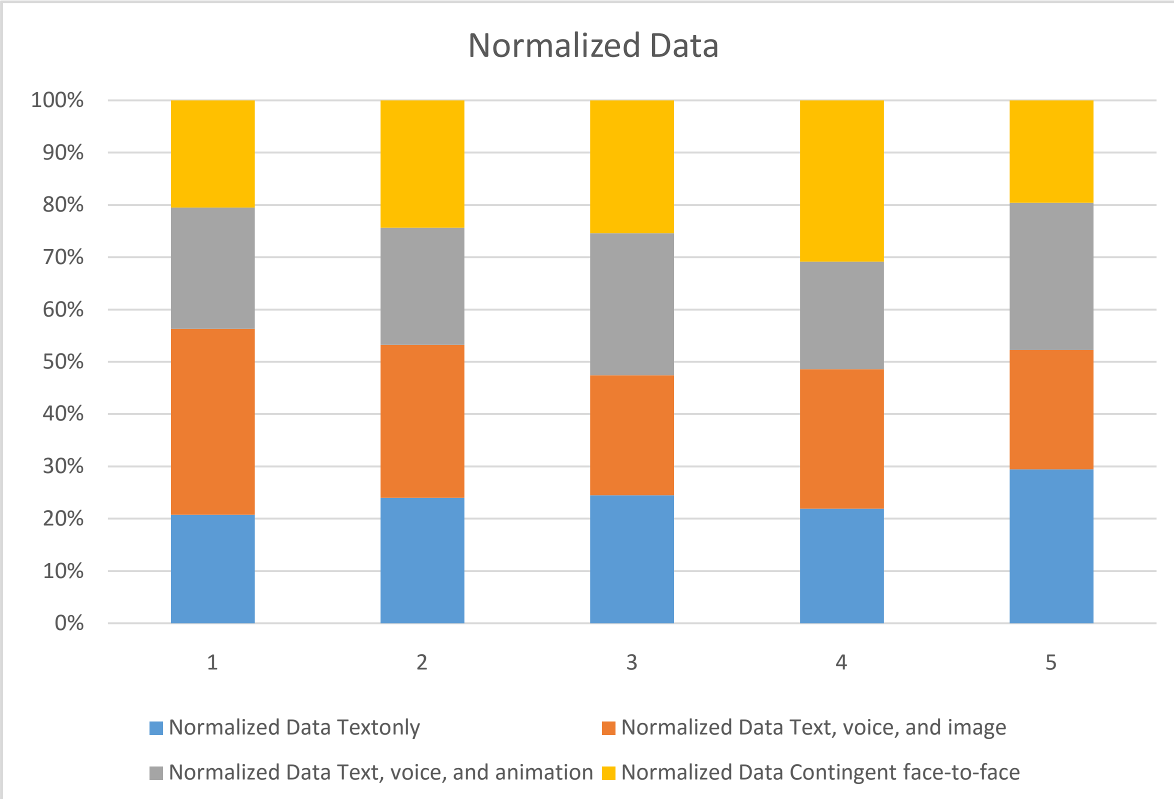

Figure 2. Normalized Data

Table 4. Weight

Weight			
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25

Table 4 Weight shows the informational set for the weight all same value 0.25.

Table 5. Weighted normalized decision matrix

Weighted normalized decision matrix			
0.096738	0.165903	0.1080937	0.095656
0.122214	0.148738	0.1138043	0.124057
0.101061	0.094766	0.1121727	0.104972
0.097242	0.118688	0.0912214	0.137008
0.136147	0.105552	0.1302316	0.090385

Table 5 Weighted normalized decision matrix shows the informational set for the Normalized Data Multiplication Weight we used the formula.

Table 6. Positive Matrix

Positive Matrix			
0.136147	0.165903	0.0912214	0.090385
0.136147	0.165903	0.0912214	0.090385
0.136147	0.165903	0.0912214	0.090385
0.136147	0.165903	0.0912214	0.090385
0.136147	0.165903	0.0912214	0.090385

Table 6 Positive Matrix shows the informational set for the value Competence 0.136147, Dominance 0.165903, Sociability 0.0912214, Task-partner attraction 0.090385.

Table 7. Negetive matrix

Negetive matrix			
0.096738	0.094766	0.130232	0.137008
0.096738	0.094766	0.130232	0.137008
0.096738	0.094766	0.130232	0.137008
0.096738	0.094766	0.130232	0.137008
0.096738	0.094766	0.130232	0.137008

Table 7 Negative matrix shows the informational set for the value Enhance the Competence 0.096738, Dominance 0.094766, Sociability 0.130232, Task-partner attraction 0.137008.

Table 8. Si Positive & Si Negative & Ci

	SI Plus	Si Negative	Ci	Rank
Competence	0.043	0.085	0.664	1
Dominance	0.046	0.063	0.578	2
Iron and steel	0.083	0.037	0.308	5
Sociability	0.077	0.046	0.373	4
Task-partner attraction	0.072	0.062	0.463	3

Table 8 Si Positive & Si Negative & Ci shows the informational set for the value this table. Final rank shows that Dominance is in Second place, Task-partner attraction in Third place, Iron and steel in the Fifth place, Competence in First place, Sociability in Fourth place. The final decision is made using the TOPSIS method.

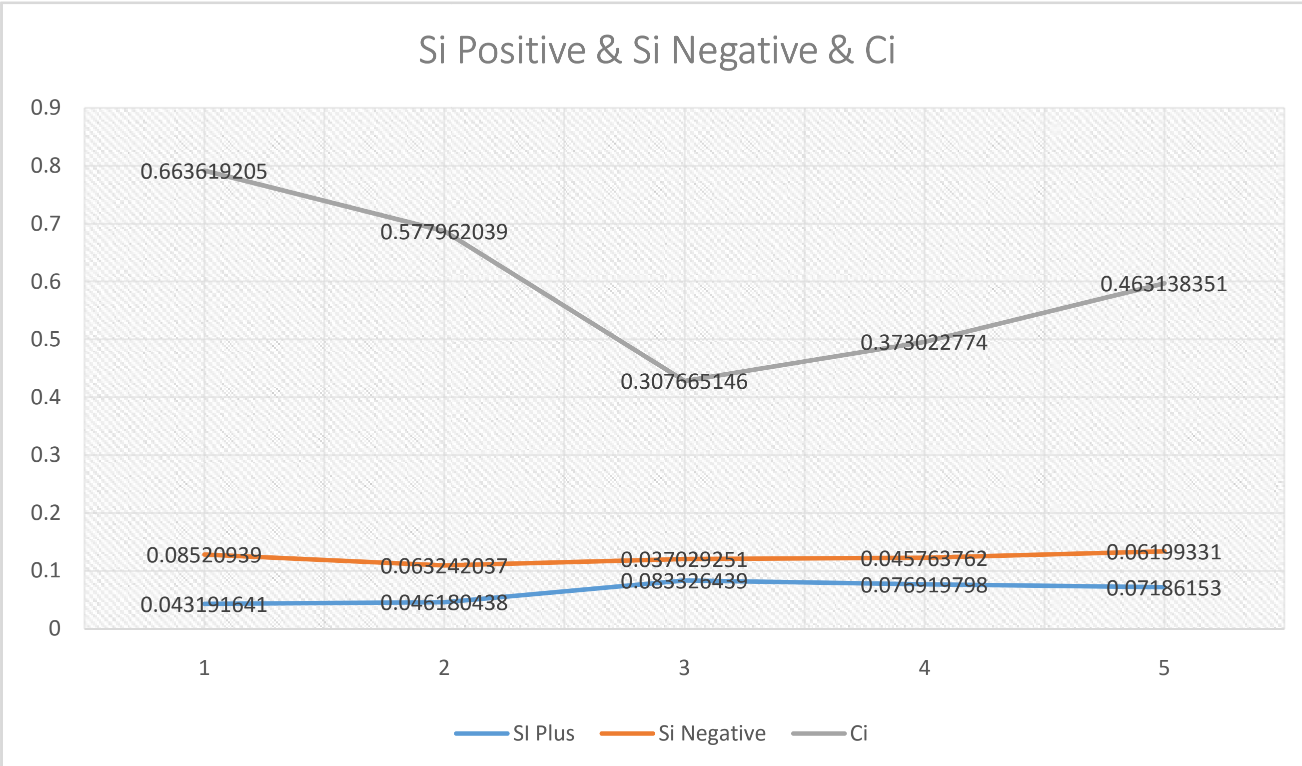

Figure 3. Si Positive & Si Negative & Ci

Figure 3 Si Positive & Si Negative & Ci shows the graphical representation.

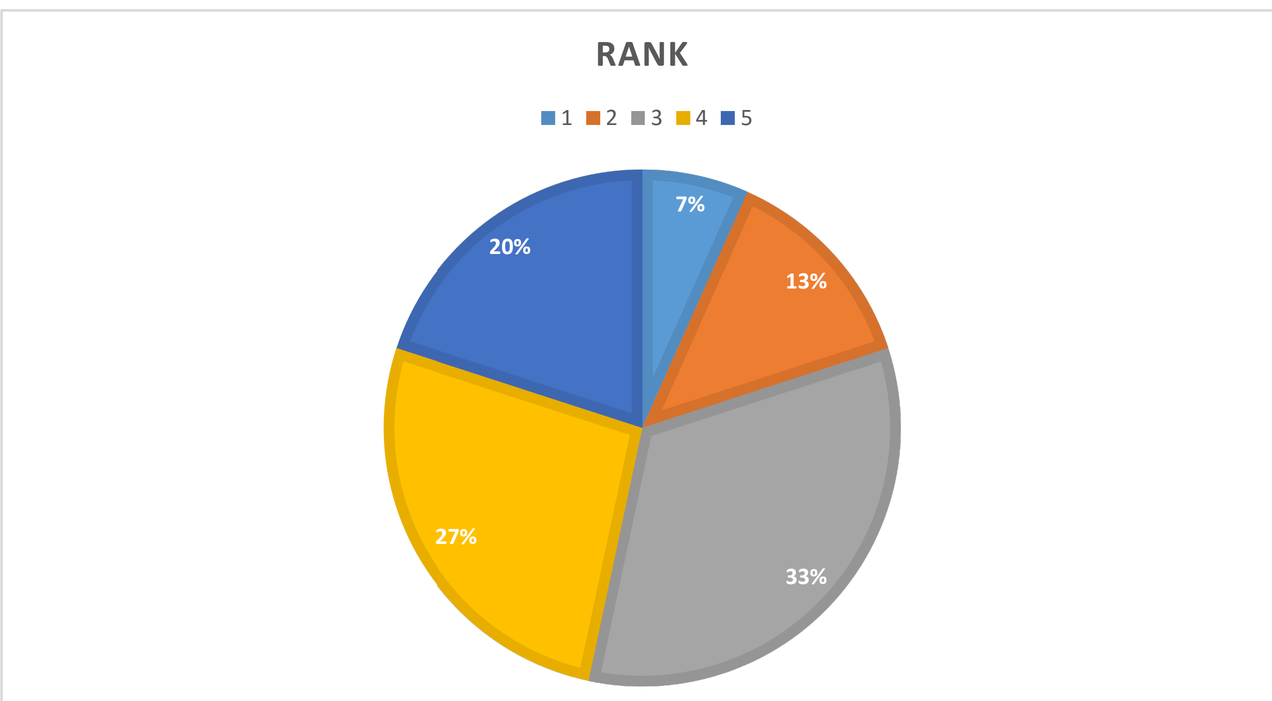

Figure 4. Rank

Figure 4 shows that Final rank shows that Dominance is in Second place, Task-partner attraction in Third place, Iron and steel in the Fifth place, Competence in First place, Sociability in Fourth place.

Conclusion

User Experience (UX): HCI is focused on creating positive user experiences by understanding the needs, preferences, and behaviors of users. A well-designed UX enhances user satisfaction, efficiency, and accessibility while minimizing frustration and errors. Accessibility and Inclusivity: HCI places emphasis on making technology accessible to everyone, regardless of physical abilities, age, or cultural background. It aims to break down barriers and design inclusively to cater to diverse user populations. Interface Design: HCI researches and develops intuitive, user-friendly interfaces that facilitate seamless interactions between users and computing systems. Effective interface design considers human cognitive processes, mental models, and visual perception. Usability: Usability is a central aspect of HCI, focusing on how easily and efficiently users can accomplish their tasks with a system.

Usability testing and evaluation help identify and address design flaws and improve system performance. Task Analysis: HCI involves analyzing user tasks and workflows to design systems that support users' goals and align with their mental models. Task analysis helps identify potential issues and opportunities for optimization. Ethical Considerations: HCI acknowledges the ethical implications of technology use and design. It addresses concerns related to privacy, data security, bias, and the potential societal impact of interactive systems. Human-Centered Design: HCI emphasizes placing human needs and capabilities at the core of the design process. By involving users early and continuously in the design cycle, HCI ensures that the resulting technologies align with real-world user requirements. Emerging Technologies: HCI adapts to new technologies and interfaces as they emerge, such as virtual reality, augmented reality, voice interfaces, and AI-powered interactions.

It explores the challenges and opportunities these technologies present for human-computer interactions. Cognitive Load and Information Processing: HCI studies how users process information and manage cognitive load during interactions. Designers aim to minimize cognitive load to enhance user performance and reduce mental strain. Continuous Improvement: HCI encourages iterative design and continuous improvement based on user feedback and changing requirements. It fosters a user-centric approach that values ongoing assessment and refinement of interactive systems.

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