

ETHNOGRAPHIC RESEARCH ON HUMAN-COMPUTER INTERACTION BEHAVIOR IN THE INTELLIGENT ERA

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Abstract: This study uses the COFE+ robot coffee kiosk as a case study to explore the current application of artificial intelligence and robotics in human-computer interaction and its limitations. Through ethnographic research, this study found that although robots perform well in automated operations and efficiency improvement, they still have obvious deficiencies in emotional interaction and social feedback, which are specifically manifested in the lack of emotional communication, the one-way and asymmetric interaction, the irreplaceable nature of interpersonal communication when human-computer interaction is not smooth, and differences in technical adaptability. These findings suggest that although robots have broad application prospects in the service industry, their ability to understand emotions and handle complex scenarios still needs further development. This study highlights the future development direction of AI and suggests improving robots' capabilities in emotion recognition and feedback, language assistance, etc. to achieve more effective human-machine collaboration and improve user experience.

Keywords: COFE+ robot coffee kiosk; Human-machine interaction; Emotional communication; Field research

1 INTRODUCTION

Significant progress has been made in the fields of artificial intelligence (AI) and robotics over the past few decades. These technologies have not only transformed industrial production, but have also gradually penetrated into daily life and the service industry. However, although robots have demonstrated high efficiency and precision in many areas, they still face major challenges in handling tasks involving emotions and complex social interactions. Current research shows that while robots are able to perform highly standardized tasks such as assembly on production lines and simple customer service, their capabilities in emotion recognition and feedback are still limited [1]. In particular, this limitation becomes evident when it comes to complex social and emotional interaction scenarios. Research on human-robot interaction not only involves how technologies work, but also how to design and deploy these technologies in different social and cultural contexts.

With the advancement of technology, more and more robots are being used in service industries such as catering, hospitality, and retail [2]. This transformation not only changes the way services are provided, but also the way customers interact with service providers. In this context, it is crucial to understand the dynamics of human-computer interaction and the challenges facing it for future technological development and transformation of human lifestyles. Especially in China, with the acceleration of urbanization and changes in social structure, innovation and technological application in the service industry have become one of the important ways to enhance economic vitality [3]. As an innovative service model, the COFE+ robot coffee kiosk in Shanghai not only represents technological progress, but also reflects the pursuit of efficiency and convenience in modern society. However, how this new service model interacts with customers in actual operation, especially how to deal with interactions involving emotions and personalized needs, is still a question worthy of in-depth study. In this context, studying how people interact with these automated machines and how this interaction affects their daily behavior and social relationships has become an important research topic. This study focuses on the following core questions: (1) What is the performance of human-robot interaction in the COFE+ robot coffee kiosk? (2) What are people's behavioral and emotional responses when using robot services? (3) What impact does this human-robot interaction have on social relations and cultural expressions?

Therefore, this study attempts to reveal the performance of robots in actual service scenarios, especially the performance and challenges in human-robot interaction, through a field survey of the COFE+ robot coffee kiosk. This not only provides valuable empirical data for understanding and optimizing current robotic services, but also provides an important reference for future technology design and social applications. This exploratory research not only helps to improve the application effect of robotics technology, but also provides support for all sectors of society to understand and accept new technologies, thereby promoting the harmonious development of technology and society.

2 LITERATURE REVIEW

2.1 Theoretical Basis of Human-Computer Interaction

Human-computer interaction (HCI) is a multidisciplinary field involving computer science, psychology, sociology, and anthropology. The human-computer communication theory proposed by Guzman [4] points out that with the advancement of technology, machines have gradually transformed from passive information transmission tools to active

communication subjects. This shift challenges traditional interaction models because machines have the ability to interact with humans to a certain extent, not only in verbal communication, but also in emotional communication through non-verbal cues. Nass et al.'s [5] "Computers Are Social Actors Paradigm" further explored that when machines can provide sufficient social cues or anthropomorphic cues, people will tend to apply human social habits to human-computer interactions. This phenomenon shows that although robots are not real social subjects, humans will naturally give them certain social roles so as to interact with them. With the development of artificial intelligence, the traditional field of human interaction has gradually expanded, and machines have begun to participate in information transmission and emotional communication as subjects in the communication process. Xiao et al. [6] pointed out that as machines gradually become the main body of communication, the relationship in human-computer interaction is also changing. In this context, human-computer communication has gradually become an important research field. Guzman [4] and his subsequent research [7] proposed that human-machine communication refers to the communication behavior after one party in the communication becomes a machine. However, when robots become the new subject of communication, what changes will occur in the relationship between humans and machines? What challenges and difficulties will be faced in the process of human-machine interaction? These issues have become particularly important with the emergence of human-machine coexistence situations.

Anthropomorphism is as the attribution of some human characteristics to non-living objects, so that these objects are perceived as living and sentient beings [8]. Nowadays, machines are not only media, but also objects of communication and interaction. As machines become more and more anthropomorphic, they increasingly reflect social characteristics. Nass et al. [5] states that as long as the machine provides enough "social cues" or "anthropomorphic cues" to make it consistent with the reality of interpersonal communication, people will be more likely to apply relevant social habits and methods in the process of communicating with the machine. Liu [9] further revealed that the relationship between humans and AI or intelligent machines has gradually surpassed the traditional logic of "ownership and belonging" and added interaction and emotional connection on this basis. Therefore, how robots express emotions during interaction has become a question worth studying.

In addition, another core issue in human-computer communication is bodily communication. The concept of bodily communication proposed by Piran and Teall [10] emphasizes the subjectivity of body perception in the process of cognitive and social interaction. Ihde [11] used the concept of "body" to concretize technological practice, obtain perception through technology, and transform this perception into human cognition, thus constructing a new relationship between humans and the world. In the process of human-computer communication, body is highlighted. This is because there are rich linguistic and non-linguistic symbols in human-computer communication. More importantly, scholars are aware of the key role of the body in the interaction process and emphasize that communication research should return to the body.

Although the above studies provide a good theoretical and empirical basis for studying new forms of human-computer communication, there are still some areas that need further exploration. In particular, practical research on human-computer communication in specific scenarios is still relatively lacking. Therefore, entering the scene of human-computer interaction and conducting field investigations has become a necessary and important basis for practical research. COFE+ robot coffee kiosk provides a good case study for solving these problems.

2.2 The Social Role and Emotional Interaction of Robots

As robots are increasingly used in public services, their roles are gradually changing. From being service tools to becoming part of human social networks, the status and functions of robots in society have surpassed those of traditional mechanical devices. In his discussion of anthropomorphism, Ricoeur [12] pointed out that when humans endow non-living objects with certain human characteristics, these objects are regarded as having life and perception. This anthropomorphism phenomenon is clearly reflected in the design and use of modern robots, especially in the process of interaction with humans, the behavior and performance of robots are often interpreted as having human attributes. Nass et al. [5] further showed that when machines have sufficient "social cues", users tend to apply the same patterns of interaction with humans to their interaction with machines. These social cues include voice intonation, facial expressions, movements, and the context of the conversation. When robots show these cues, people tend to view them as "acting subjects" with social roles, which leads to robots being gradually incorporated into human social circles and becoming a new medium of communication.

This social role not only changes the way people interact with robots, but also makes robots occupy a new position in the social structure. Liu [9] further explored the emotional connection between people and intelligent machines in their research, pointing out that this connection has gone beyond the traditional logic of "owning and being owned" and entered a more complex level of interaction and emotional connection. As robotics technology continues to advance, the relationship between humans and machines is changing from simple tool use to a more complex and multi-layered interactive relationship that is not only functional but also includes emotional and social identity factors. In addition, the research also shows that as robots play an increasingly important role in human society, how to design and build robots to better support such emotional interactions has become an important direction for technology development and social science research.

In summary, the application of robots in public services has gone beyond simple tool roles. They are becoming part of human social networks and establishing complex emotional connections with humans through the expression of anthropomorphism and social cues. This trend poses new challenges and opportunities for future technology design and

social applications, prompting researchers and developers to continuously explore how to better achieve emotional interaction and social integration between humans and machines.

3 RESEARCH METHOD

Ethnography is a qualitative research method that is mainly used to study the lifestyle, beliefs, customs and behaviors of a specific society, culture or group [13-14]. Through in-depth field investigation, ethnography aims to understand the social and cultural phenomena of the research subjects from their internal perspective. Field research emphasizes the acquisition of data through in-depth observation and participation in the behavior of people in a specific social environment. Wolcott [15] believes that field research is not only a means of data collection, but also a "personal observation mode". In this process, the researcher himself becomes a research tool, able to capture people's behavior, culture and lifestyle in a natural environment.

Marcus [16] proposed that the advantage of field research is that it can discover the patterns and meanings hidden behind daily behaviors, especially in complex social interactions, field research can reveal the deep cultural connotations beneath surface behaviors. For this study, field research can help understand the behavioral patterns and socio-cultural significance of people's interactions with robots in the specific scenario of the COFE+ robot coffee kiosk. This study adopts the field investigation method and selects Shanghai COFE+ Robot Coffee Kiosk as the research site. The advantage of this method is that it can conduct continuous observation in a natural environment, thus capturing the real scene of human-machine interaction. Through observation, I recorded customers' behaviors, language, and emotional responses when using robot services, which provided first-hand data for understanding human-machine interaction.

In addition, I took on the role of a "participant observer" during the fieldwork, which meant that I not only recorded other people's behaviors as a bystander, but also personally experienced the service process of the robotic coffee kiosk. In this way, I was able to gain a deeper understanding of people's feelings and reactions in this interaction, thus providing a more comprehensive perspective for the research. Data mainly come from participant observation and field notes. In data analysis, I used thematic analysis [17], which is particularly suitable for dealing with complex and messy data. By coding and classifying the data, key themes can be found, thereby revealing the meaning and patterns behind the data.

In field research on human-computer interaction, the study follows several key ethical principles [18]. First, ensure that participants are aware of the purpose and methods of the study. Second, protect participants' information through methods such as anonymization and data encryption. Third, respect the cultural background of the participants and avoid the influence of cultural bias on the research results. Continuously reflect on the impact of one's own role on the research scenario and adjust observation methods to maintain ethical standards.

4 RESULTS

4.1 The Unidirectionality and Asymmetry of Human-computer Interaction

In the COFE+ robot coffee kiosk scenario, although the robot has highly automated operating capabilities and can effectively handle specific tasks such as coffee making to meet the basic needs of customers, it shows obvious limitations in terms of emotional communication and body language feedback. This limitation stems from the current technology's inability to process human emotions and complex body language, resulting in a one-way and asymmetric interaction process between humans and machines. As Nass et al. [5] pointed out, when machines cannot provide sufficient social cues or anthropomorphic feedback, communication between humans and machines will find it difficult to achieve a two-way interactive effect similar to interpersonal communication.

In actual observations, customers often try to interact with robots through touch, language, etc., but because the machines lack the ability to provide feedback on these interactions, the interaction process cannot continue. This not only limits the depth of interaction, but also makes customers feel that the communication with the machine is one-sided and incomplete. The research of [9] further supports this view, arguing that in current human-computer interaction, despite significant technological progress, it is still unable to completely transcend the traditional logic of "ownership and belonging" and lacks real interaction and emotion. connect. This one-way interaction model emphasizes the limitations of current artificial intelligence technology in dealing with human emotions and social interactions, and also suggests an important direction for future technological development, namely how to achieve more natural and effective two-way communication between humans and machines through more complex and detailed designs.

In addition, the lack of emotional interaction is a prominent phenomenon. The study found that when customers use the robotic coffee kiosk, they often try to interact by touching the glass or speaking to the robot, behaviors that indicate that customers want to establish some kind of emotional connection with the robot. However, the robot was unable to give any effective response to these emotional interactions. When machines cannot provide sufficient social cues or emotional feedback, humans will feel that their interaction with machines is incomplete and lacks the mutual understanding and response in interpersonal communication [19]. For example, when customers try to elicit a response from the machine through language or touch, they receive no feedback, which makes the interaction seem cold and mechanical, far from the interactive experience that customers expect. This lack of emotional interaction not only affects the customer experience, but also reveals the inherent challenges of robots in dealing with emotional communication. The relationship between humans and intelligent machines is gradually moving beyond traditional

functional use and entering the stage of emotional connection [20].

4.2 The Difference Between Technology Acceptance and User Adaptability

As technology continues to penetrate into our lives, there are significant differences in users' acceptance and adaptability to new technologies. This study found that young people are more inclined to try using robots to make coffee, while older people tend to watch from a distance and do not actively participate. This difference may be due to the fact that young people have a natural curiosity about and greater ability to learn new technologies, while older people are more unfamiliar with new technologies. For example, older people often seek help from younger people on how to operate the robotic coffee machine. This highlights the importance of young people's role as "technology intermediaries". In addition, when users are unfamiliar with the operation of the robot, it may lead to poor operation and user experience, thus affecting their overall evaluation of the technology. However, it is worth noting that the robot coffee machine also has a language guidance function, which can actively help users complete operations to a large extent. Therefore, the design of future technology should pay more attention to user diversity and provide more friendly and easy-to-understand operating interfaces and guidance methods to enhance the user experience of users of all ages.

4.3 The Irreplaceable Role of Interpersonal Communication

In the context of the COFE+ robot coffee kiosk, the irreplaceable role of interpersonal communication is particularly prominent. Although robots are highly efficient in automating services and can handle basic tasks such as making coffee, when they are unable to effectively respond to customers' complex needs, customers often turn to traditional human interaction to make up for this shortcoming. This phenomenon shows that although artificial intelligence technology has made great progress in many fields, there is still a significant gap between machines and humans in handling complex situations and emotional communication.

In particular, when customers encountered problems in their interactions with the robot, such as not being able to find coffee or being unsure how to operate the machine, they often sought help from other customers. This behavior not only illustrates the limitations of robots in responding to non-standardized human requests, but also emphasizes the core role of human communication in these scenarios. As Solomon and Theiss [21] noted, interpersonal communication has greater openness and flexibility, allowing for immediate and personalized feedback and support in complex and dynamic environments.

In addition, research by Guzman and Lewis [7] further demonstrated that although AI can surpass humans in specific tasks, human capabilities still dominate when it comes to social interaction and emotional understanding. That's because human communication is not just about information, but also about the exchange of emotions and social cues.

When robots can't understand or respond to these cues, human communication becomes an indispensable supplement. For example, when a customer couldn't find his or her coffee at a kiosk, the help of other customers not only solved the practical problem, but also established an instant social connection through interaction, which cannot be replaced by current robots. This further proves that in service scenarios where human-machine interaction has not yet fully matured, interpersonal communication still plays a key role. Although technological advances have enabled machines to handle increasingly complex tasks, human communication is still irreplaceable when it comes to emotional understanding, social interaction, and unstructured problems. This dependence also suggests the direction of future technological development, namely how to design robots that are more socially and emotionally sensitive to better support human-machine collaboration in complex service scenarios.

5 DISCUSSION AND CONCLUSION

This study reveals the current application status and limitations of artificial intelligence and robotics in the service industry through an in-depth analysis of the human-machine interaction scenarios of the COFE+ robot coffee kiosk. First, the study found that although robots perform well in automated operations and efficiency improvements, their shortcomings in emotional interaction and social feedback are still significant. Secondly, the lack of emotional interaction further highlights the limitations of current robotics technology. Although customers often try to interact more deeply with robots through touch or language, the interactive experience fails to meet customer expectations because the machines cannot respond to these emotional needs. Finally, a key finding of this study is the irreplaceable role of human communication. Although robots can handle standardized and repetitive tasks, customers often rely on human communication to solve problems when human-robot interaction is not smooth or problems arise.

Overall, the case study of the COFE+ robot coffee kiosk illustrates that although AI and robotics technology show great potential in the service industry, there are still major deficiencies in emotional interaction and complex scene processing. One-way and asymmetrical interaction patterns, irreplaceable human communication, lack of emotional feedback, and differences in technological adaptability are all areas where current robotics technology needs further development. This study suggests that future AI development should focus not only on improving operational efficiency, but also on enhancing robots' social and emotional understanding capabilities, enabling them to achieve effective human-machine collaboration in a wider range of more complex service scenarios. Additionally, this study also provides a practical reference for human-computer interaction design in the service industry. It is suggested that when designing and deploying robots, the importance of human emotional needs and social interaction should be considered, and robots should be made more humane by improving technology, thereby enhancing user experience and optimizing service

processes.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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