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APPLICATION OF ANTHROPOMORPHIC DESIGN IN CHATBOT DIGITAL AVATARS: A COMPARATIVE ANALYSIS OF ABSTRACT AND FIGURATIVE REPRESENTATIONS

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*Abstract. **The purpose.** This study aims to investigate the application and impact of anthropomorphic design in chatbot digital avatars, focusing on the transition from mechanistic to human-like interfaces. The research analyzes abstract and figurative anthropomorphism, examining their respective roles in improving user engagement and experience. By exploring how abstract designs simplify human traits for enhanced recognition and figurative designs emulate real human expressions for more natural interaction, the study underscores the importance of emotional communication in chatbot design. The findings suggest potential avenues for future research in affective computing and human-computer interaction.*

***Methodology.** Literature analysis method: A comprehensive review of existing literature on anthropomorphic design, chatbot digital avatars, and human-computer interaction was conducted to establish a theoretical basis for the study. Interdisciplinary research method: The theories and methods of different disciplines were integrated to examine various chatbot digital avatars using abstract and concrete anthropomorphic designs to understand the design choices and their impact on user experience.*

***The research results.** The study identifies two main categories of anthropomorphic design for chatbot digital avatars: abstract and figurative. Abstract avatars use simplified, cartoon-like expressions to convey emotions, creating friendly and approachable digital personas that enhance user acceptance. Figurative avatars, on the other hand, emphasize realism, imitating human body language, expressions, and voice tones to provide a deeper interactive experience. These design styles offer unique benefits, allowing customization based on specific user needs and application contexts.*

***The scientific novelty.** This research offers a comparative framework for analyzing abstract and figurative anthropomorphic designs in chatbot avatars, focusing on their impact on user engagement and emotional response. Unlike previous studies centered on functionality, this study highlights the psychological effects of avatar design, categorizing elements like facial expressions and gestures to optimize user-centered design. This contributes to human-computer interaction by enhancing*

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understanding of how avatar design fosters emotional connection and user satisfaction.

The practical significance. *The findings of this study offer valuable insights for designers and developers in the chatbot and AI interface design field. By understanding the impact of abstract and figurative anthropomorphic elements, designers can make more informed choices in selecting avatar styles that align with user preferences and application needs. Abstract avatars may be particularly effective in contexts that require approachability and simplicity, such as customer service applications. In contrast, figurative avatars can enhance user engagement in scenarios that benefit from realism and emotional depth, such as healthcare or education. This research also provides actionable guidelines for implementing anthropomorphic elements – such as facial expressions, gestures, and voice modulation – that foster emotional connection and user satisfaction, ultimately contributing to a more effective and enjoyable human-computer interaction experience.*

Keywords: design, abstract anthropomorphism, figurative anthropomorphism, chatbot design, user experience, interface design, intelligent chatbot.

INTRODUCTION

Anthropomorphism has been an important concept in various fields, including psychology, design, and technology, which refers to giving non-human entities human-like characteristics [6]. In the process of gradually transforming from mere "machines" to real "robots", the integration of anthropomorphism has enabled robots to gradually get rid of their simple tool nature and acquire more complex social characteristics. Anthropomorphism has begun to play an increasingly important role.

As the first source of impression in human-computer interaction, anthropomorphic visual design is an essential factor affecting users' emotional experience and acceptance. In recent years, anthropomorphism has attracted much attention in the digital avatar design of chatbots. The anthropomorphic design of visual and behavioral characteristics is widely used in the digital avatar design of chatbots. The goal is to create more attractive and user-friendly avatars – it is a digital avatar. By simulating human vision and behavior, including facial expressions, gestures, and conversational styles, chatbots can establish a more comfortable user interaction experience, thereby creating more immersive, intuitive, and natural interactions. In addition, anthropomorphism can also promote emotional connections between users and chatbots, resulting in a more meaningful and memorable user experience and increased user acceptance [1]. The anthropomorphic characteristics of intelligent chatbots have also attracted increasing attention from the academic community. For example, Cheng studied the relationship between the emotional anthropomorphic characteristics of intelligent chatbots and the perceived trust and acceptance willingness of users and intelligent chatbots [8]. The results showed that the anthropomorphic attribute "warmth" positively impacts perceived trust, and the higher the warmth of the intelligent chatbot, the more positive the user's willingness to accept it. Selamat studied the impact of anthropomorphic features (such as fun and pleasantness) of intelligent chatbot conversation methods on users' purchase intention [17]. The results show that the fun and pleasantness of intelligent chatbot dialogue have a significant positive impact on users' purchase intention, which can enhance users' willingness to use.

An in-depth understanding of the impact of anthropomorphic design on chatbot user experience is crucial to the design and development of effective and user-friendly digital representations for human-computer interaction. The anthropomorphic design of digital avatars reflects the human-centered design concept of technology and is an effective means to bridge the distance between users and technology [9]. This paper studies the evolution process of anthropomorphic digital avatars of different brands of chatbots, analyzes the design and application of anthropomorphic elements of different categories of digital avatars, and the impact of the anthropomorphic design of different categories of digital avatars of chatbots on user experience. This research provides an important design theoretical reference for the cognition and understanding of the anthropomorphic design of the digital avatar of intelligent chatbots, and for reasonably avoiding the "uncanny valley effect".

ANALYSIS OF PREVIOUS RESEARCHES

In related research in the field of human-computer interaction, the concept of

anthropomorphism can be explained as a tendency to attribute human characteristics to inanimate objects, animals, and other entities to help people understand and rationalize their behaviors [5]. More simply, anthropomorphism describes the tendency to attribute human-like characteristics, motivations, intentions, or emotions to non-human entities so that the interacting subjects can realistically feel or imagine their human-like behavior [16]. Chatbots can simulate human conversational behavior and provide information or entertainment interactions. Consumers can interact with it through various methods such as text and voice, such as Amazon's Alexa and the famous ChatGPT. Chatbots with strong interactive capabilities can enhance consumer trust, which is very important for companies to strengthen their relationships with consumers [4]. From a technical perspective, anthropomorphism is the addition of human-like characteristics to non-human objects. The reason for anthropomorphism is that it can improve consumers' sense of control and confidence and create a sense of comfort for customers. The higher the degree of anthropomorphism of the chatbot, the higher the consumer's compliance and willingness to adopt the chatbot's suggestions [11]. Previous research has explored how visual signals (avatars of people), identity signals (people's names or identities), and verbal signals have the potential to elicit human schemas, which in turn influence people's judgments, attitudes, and behaviors. Anthropomorphism theory states that introducing anthropomorphic cognition Relevant to the customer's purchase intention. Research by Landwehr, McGill and Herrmann found that consumers prefer products with friendly grilles and aggressive headlights, which they call a "baby face" expression [13]. This expression induces positive emotional states of high pleasure and excitement, thereby increasing product liking and sales. The authors also found that the effects of facial expressions were moderated by product category and consumer characteristics such as gender and cognitive needs [13]. As a result, considerable attention to anthropomorphic themes in academic and business circles has resulted in brand mascots, brand personalities, marketing myths, and anthropomorphism in product design and advertising [3]. New areas of anthropomorphism have emerged with developments in projective research methods, digital avatars, robot design, digital self-presentation, and conversational digital assistants such as Amazon's Alexa and Apple's Siri [10]. Product designers and brand managers often prompt consumers to view their goods and trademarks as anthropomorphic through the use of visual features or brand mascots [7]. Recent advances in artificial intelligence and machine learning have brought about a new trend of highly anthropomorphic devices in digital scenarios, from human-like self-driving cars to voice-activated digital assistants with human names and voice patterns. Anthropomorphic technology can not only improve User perceived capabilities and performance but also improve user satisfaction and engagement [12].

Anthropomorphic interfaces have significant potential to enhance trust in technology, not only by increasing the level of capability awareness but also by making people more resilient to trust breakdowns and assisting robots in quickly recovering from process failures [8]. In the case of a chatbot, a user's level of trust in it is influenced by a variety of factors, including its behavior and appearance, as well as the behavior, privacy concerns and protections associated with the service provider The formation of a trusting connection is further facilitated by the chatbot's human likeness, including its visual characteristics and similarity to humans [15]. In addition, anthropomorphism can stimulate psychological warmth, provide emotional value, and encourage users to display compensatory behaviors toward robots [14].

However, most authors still agree that human-like digital characters or avatars can improve the online shopping experience by taking into account the emotional state of the customer, and both avatars and other anthropomorphic cues in chatbot can facilitate shopping [18]. Existing research has shown that anthropomorphism can strengthen the positive emotional connection between consumers and enterprises and increase consumers' sense of competence in artificial intelligence recommendations [19]. Moreover, consumers' social response to artificial intelligence depends to a certain extent on the number of anthropomorphic cues. That is, having more human-like characteristics will trigger a stronger social response from customers and increase their sense of identity and social belonging [10]. Since consumers' energy, time and other resources are limited, interacting with human-like chatbot can easily make consumers willing to accept more business information. Anthropomorphic digital products can even become friends with users, making consumers less willing to switch to other brands' products, thus increasing customer brand loyalty [4].

PURPOSE

This study aims to investigate and compare the effects of abstract and figurative

anthropomorphism design in chatbot digital avatars on user interactions and experiences. By systematically analyzing the unique design elements of abstract and figurative anthropomorphism, it is advisable to determine how each design approach affects user perceptions, such as trust, engagement, and emotional connection. This analysis is expected to provide specific insights into design choices that improve user satisfaction and interaction quality. In addition, the research is expected to provide a clear design guideline for designers in the field of human-computer interaction (HCI) and digital avatar design to guide the future development of emotionally intelligent and user-friendly chatbot digital avatar designs.

RESULTS AND DISCUSSION

1. Evolution and classification of anthropomorphic design of digital avatar of chatbot

With the rapid development of natural language processing and artificial intelligence, robots have gradually acquired the ability to hold conversations and understand language. Chatbot is a very popular new technology in recent years, also known as AI chatbot, conversational agent, digital assistant or virtual assistant, etc.

Judging from the historical data that can be traced, chatbots have been around since at least the 1960s. After nearly 50 or 60 years of development, from the perspective of technological history, the upgrading of technology has transformed chatbots from a supporting role, gradually developed into intelligent employees with comprehensive functions and even capable of acting alone [2]. People's demand for this technology also gradually expanded into personal assistants that can take into account tasks and social needs. Currently, chatbots are widely used in customer service, marketing, education, medicine, and other business fields to replace human labor. With the support of artificial intelligence and machine learning technology, chatbot interactive communication capabilities and problem-solving abilities have been continuously improved, showing immeasurable business application prospects. Today we can already see the shadow of chatbots in many products, such as Microsoft’s Cortana, XiaoIce, etc.

In recent years, to provide a better user experience, the digital avatar design of intelligent chatbot has transformed mechanization into anthropomorphism, focusing on interactive design. Anthropomorphic digital avatars interact with users more vividly and intuitively through animation effects, sounds, and tactile feedback, thereby enhancing users' sense of participation and experience. The early digital avatar design of intelligent chatbot was more mechanical and cold, emphasizing technical features. However, with the development of human-computer interaction, designers have begun to incorporate more interactive elements into digital avatars. Take Apple's Siri as an example. The original Siri was a simple microphone shape, composed of a two-dimensional rectangle, with a relatively single color, which was consistent with Apple's design philosophy. However, over time, Siri's digital avatar has undergone many improvements, adopting changing wavy stripes and gradient colors to make it more technological and artificially intelligent. These changes not only refine the visual experience but also improve users’ trust. In addition, with the further development of technology, the functions of intelligent chatbot become more powerful. The digital avatar not only has human appearance characteristics, but also displays emotions and body movements, making the robot more human-like and easier to establish an emotional connection with the user. The appearance of the digital avatar is more friendly and approachable, and the communication process focuses on emotional expression and tone to better meet user needs. This development trend has pushed digital presence to new heights, providing users with a richer experience.

Thus, to bring people a better user experience, the design style of the visual digital avatar of intelligent chatbots has changed from mechanization to anthropomorphism, and more and more attention has been paid to the application of anthropomorphic design. The traditional digital avatar design style mainly emphasizes the function and practicality of the robot, while the anthropomorphic visual digital avatar design style pays more attention to the emotional communication and interaction between the digital avatar and the user, emphasizes the similarity between the digital avatar and human beings, and improves the user experience. participation and experience. With the continuous development and popularization of artificial intelligence technology, the design style trend of intelligent chatbots will pay more attention to the emotional communication and interaction between visual digital avatars and users. At the same time, it will also pay more attention to the simplicity and clarity of digital visual avatars to satisfy different users.

Anthropomorphism is the concept of attributing unique human-like characteristics, motivations, intentions, behaviors, and emotions to inanimate objects or non-human beings. In

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interactions with chatbots, digital avatar design is the main way to achieve anthropomorphism. It can intuitively express human characteristics, improve user experience, enhance interaction with users, and shape a specific brand avatar. Observing the anthropomorphic characteristics of existing chatbot digital avatars can divide the anthropomorphic digital avatars of chatbots into two categories: abstract anthropomorphism and figurative anthropomorphism.

2. Abstract anthropomorphism

Abstract personification is an important expression method in the field of digital avatar design. It creates digital avatars with cartoon characteristics by simplifying and abstracting the characteristics of human facial expressions. This design method has multiple advantages. First, during the design process, abstract personification simplifies the details and characteristics of human facial expressions, making the digital avatar more concise and clear, and easier to be recognized and accepted by users. Secondly, abstract personification emphasizes the cartoon processing of expressions, highlighting certain features of expressions through exaggeration and deformation, making expressions more lively and lively, and enhancing the visual appeal of digital avatars. In addition, abstract personification also focuses on introducing diverse facial expressions and movements, enriching the emotional expression ability of digital avatars and adding more fun and emotional connection to the interaction between users and robots. Finally, abstract personification creates a distinctive digital avatar through unique color schemes and styling styles, enhancing the recognition and brand value of the digital avatar. Abstract anthropomorphism, as a creative and dynamic digital avatar design method, provides a more pleasant, vivid and attractive experience for the interaction between users and robots. It will still play an important role in design practice in the future, providing digital avatar design injects more creativity and vitality. The main design elements of abstract anthropomorphism used in digital chatbot avatars are as follows:

Smile and Eye Communication: smiling is considered a universally recognized expression of pleasure. By cleverly designing smiles into your digital presence, you can increase the friendliness and positive emotions users feel. Eye communication includes actions such as direct gaze and blinking. These actions simulate eye contact in real conversations and improve the realism of the interaction (Fig. 1).

Facial expressions and eyebrow movements: Xiaopeng's Xiao P digital avatar introduces various facial expressions such as surprise, anger, sadness, etc. (Fig. 2), which can respond to the user's emotions more accurately. The expression changes of eyebrows are also an important element, conveying different emotional states and increasing the diversity of emotion recognition.

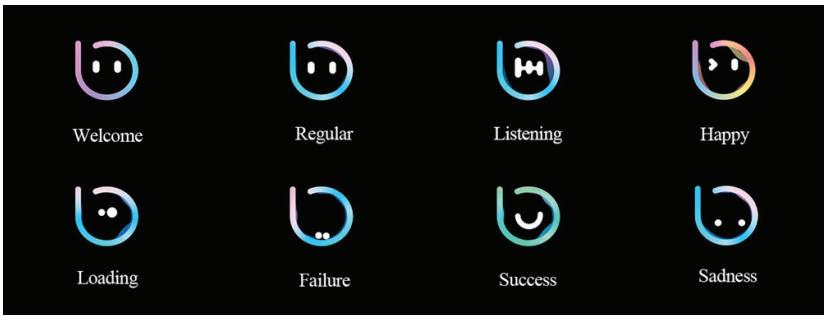

Fig. 1. Samsung's Bixby digital avatar

Fig. 2. Xiao peng's Xiao P digital avatar

The head posture and gestures of the digital avatar, with the ability to turn the head and nod, simulate human body language, making communication more natural. Introducing gestures, such as waving, nodding, etc., can respond to users more vividly and strengthen the interaction between users and robots. In terms of expression changes and voice tones, introducing a variety of expression changes such as happiness, sadness, anger, etc. can more accurately respond to the user's emotions and words (Fig. 3).

Adjusting the voice pitch to make it more consistent with the corresponding emotional expression is also an effective means to improve the expressiveness of the robot. In terms of color changes and body postures, if the digital avatar has color or lighting effects, different emotional states can be expressed through color changes (Fig. 4). The design of body postures, such as a straight body to express confidence, a lowered head to express modesty, etc., can further enhance the diversity of emotional expression.

Fig. 3. Nio's NOMI digital avatar

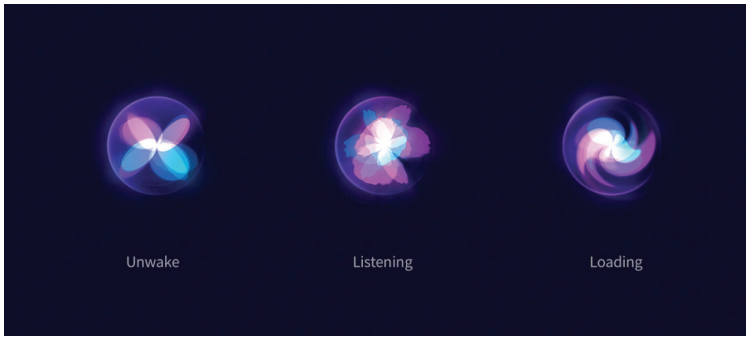

Fig. 4. Apple's Siri digital avatar

By designing the digital expression avatar characteristics of anthropomorphic chatbot in detail, we can imitate the natural communication methods between humans, improve the robot's sensitivity to user emotions, and enhance the user experience. Future research can further deepen the discussion of affective computing and human-computer interaction and provide more inspiration for the development of anthropomorphic chatbots.

3. Figurative anthropomorphism

Figurative anthropomorphism is a realistic humanized design of digital avatars, emphasizing a more intuitive way of expression. It plays an important role in digital avatar design and provides a more vivid, natural and attractive experience for the interaction between users and robots. By imitating the body language, expression changes and voice pitch of real humans, figurative anthropomorphic digital avatars can more accurately simulate human emotions and communication methods, improving the interactive experience between users and robots. The following are the main design elements of figurative anthropomorphism used in the digital avatar of the chatbot:

Head pose and gestures: the head pose of Mi AI's digital avatar is designed to simulate the head movements of real people (Fig. 5). By having the ability to turn their heads and nod, digital avatars can more naturally express emotional states such as understanding, agreement, or disagreement. The introduction of gestures emphasizes the importance of body language. Actions such as waving and nodding can respond to users more vividly and enhance the interaction between users and robots.

Fig. 5. Mi AI's digital avatar

Expression changes and voice pitch: in figurative anthropomorphism, the introduction of expression changes and voice pitch greatly improves the robot's accurate response to the user's emotions. By introducing a variety of expression changes, such as happiness, sadness, anger, etc., digital avatars can more accurately simulate human emotional expressions, making the user experience richer. The adjustment of the voice pitch makes the robot's voice more consistent with the corresponding emotional expression, further enhancing the robot's expressiveness and providing richer context and communication effects for interaction.

Body posture: in figurative anthropomorphism, the body posture design of the digital avatar is a key element of emotional expression (Fig. 5). By designing different body postures, such as a straight body to express confidence, a lowered head to express modesty, etc., digital avatars can express various emotional states more comprehensively and increase the natural feeling of interaction.

These design elements are comprehensively used in figurative personification to build a digital avatar that is more humane and closer to real communication. The synergy of head posture, gestures, expression changes, voice pitch and body posture allows the robot to more accurately simulate human emotions and communication methods, improving the interactive experience between the user and the robot. Through the figurative anthropomorphic design, the digital avatar more vividly reflects the rich emotions and expressions in real social communication, providing a more realistic experience for the anthropomorphic chatbot to shape the user's psychological construction.

Generally speaking, these two avatar design methods have their advantages. The abstract anthropomorphic avatar pays more attention to cartoon characteristics, making the robot avatar more relaxed and pleasant, and easier for users to accept. The figurative anthropomorphic avatar puts more emphasis on realism, making the robot more realistic when simulating interpersonal communication and providing a deeper user experience. In practical applications, abstract or figurative anthropomorphic avatars can be flexibly selected according to different user groups and application scenarios to achieve the best interactive effect. Future research can further deepen the discussion on anthropomorphic avatar design and combine research on emotional computing and human-computer interaction to provide more innovation and inspiration for the development of anthropomorphic chatbot.

CONCLUSIONS

This study provides a comparative analysis of abstract and figurative anthropomorphism in chatbot digital avatars, revealing how each approach affects user engagement, emotional connection, and overall interaction quality in unique ways. Abstract anthropomorphism is characterized by simplified, cartoon-like features that create a friendly, approachable vibe, making chatbots more acceptable and usable, especially in informal or entertainment-focused applications. In contrast, figurative anthropomorphism features realistic human-like attributes that help build deeper emotional connections and more immersive experiences, which can be particularly beneficial in professional or support-based environments. These findings highlight the importance of choosing anthropomorphic design styles that align with intended use cases and user expectations. The insights gained from this study can inform future design practices, encouraging more strategic and context-sensitive applications of anthropomorphism in chatbot avatars. By incorporating these design principles, digital avatar designers and developers can create more effective, intuitive, and engaging digital avatars, thereby advancing the field of human-computer interaction.

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АНОТАЦІЯ

Ма Нін, Хиневич Р. Застосування антропоморфного дизайну в цифрових аватарах чат-ботів: порівняльний аналіз абстрактних та образних репрезентацій.

Метою *дослідження є вивчення застосування та впливу антропоморфного дизайну в цифрових аватарах чат-ботів, зосереджуючись на переході від механістичних до людиноподібних інтерфейсів. Дослідження аналізує абстрактний та образний антропоморфізм, вивчаючи їхню роль у покращенні залучення користувачів та їхнього досвіду. Вивчаючи, як абстрактний дизайн спрощує людські риси для кращого розпізнавання, а образний дизайн імітує реальні людські вирази для більш природної взаємодії, дослідження підкреслює важливість емоційної комунікації в дизайні чат-ботів. Отримані результати відкривають потенційні шляхи для майбутніх досліджень у сфері афективних обчислень та взаємодії людини та комп'ютера.*

Методологія. *Метод аналізу літератури: було проведено комплексний огляд існуючої літератури про антропоморфний дизайн, цифрові аватари чат-ботів та взаємодію людини з комп'ютером, щоб створити теоретичну основу для дослідження. Міждисциплінарний метод дослідження: теорії та методи різних дисциплін були об'єднані для вивчення різних цифрових аватарів чат-ботів з використанням абстрактних і конкретних антропоморфних дизайнів, щоб зрозуміти вибір дизайну та його вплив на досвід користувача.*

Результати дослідження. *Дослідження визначає дві основні категорії антропоморфного дизайну для цифрових аватарів чат-ботів: абстрактна та образна. Абстрактні аватари використовують спрощені, мультяшні вирази для передачі емоцій, створюючи дружні та доступні цифрові образи, які підвищують сприйняття користувачами. З іншого боку, образні аватари підкреслюють реалістичність, імітуючи мову людського тіла, вираз обличчя та тональність голосу, щоб забезпечити більш глибокий інтерактивний досвід. Ці стилі дизайну пропонують*

унікальні переваги, дозволяючи кастомізувати їх відповідно до конкретних потреб користувачів і контексту програми.

Наукова новизна. *Це дослідження пропонує порівняльну базу для аналізу абстрактного та образного антропоморфного дизайну аватарів чат-ботів, зосереджуючись на їхньому впливі на залучення користувачів та емоційну реакцію. На відміну від попередніх досліджень, сфокусованих на функціональності, це дослідження висвітлює психологічні ефекти дизайну аватарів, класифікуючи такі елементи, як вираз обличчя та жести, для оптимізації дизайну, орієнтованого на користувача. Це сприяє взаємодії між людиною та комп'ютером, поглиблюючи розуміння того, як дизайн аватара сприяє емоційному зв'язку та задоволенню користувачів.*

Практична значущість. *Результати дослідження містять цінну інформацію для дизайнерів і розробників у сфері дизайну інтерфейсів чат-ботів і ШІ. Розуміючи вплив абстрактних та образних антропоморфних елементів, дизайнери можуть робити більш обґрунтований вибір при обранні стилів аватарів, які відповідають уподобанням користувачів та потребам програми. Абстрактні аватари можуть бути особливо ефективними в контекстах, які вимагають доступності та простоти, наприклад, у додатках для обслуговування клієнтів. На противагу цьому, образні аватари можуть підвищити залученість користувачів у сценаріях, які виграють від реалістичності та емоційної глибини, наприклад, у сфері охорони здоров'я або освіти. Надано практичні рекомендації щодо впровадження антропоморфних елементів – таких як вираз обличчя, жести і модуляція голосу, які сприяють емоційному зв'язку і задоволенню користувачів, що в кінцевому підсумку допомагає більш ефективній і приємній взаємодії людини з комп'ютером.*

Ключові слова: дизайн, абстрактний антропоморфізм, образний антропоморфізм, дизайн чат-ботів, досвід користувача, дизайн інтерфейсів, інтелектуальний чат-бот.

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