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Design of intelligent psychological cloud service application
การออกแบบระบบบริการคลาวด์อัจฉริยะเพื่อการสนับสนุนสุขภาพจิต

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บทคัดย่อ

ในบริบทของการเพิ่มขึ้นอย่างต่อเนื่องของปัญหาสุขภาพจิตทั่วโลก ขณะเดียวกันระบบบริการสุขภาพจิตแบบดั้งเดิมยังเผชิญข้อจำกัดด้านการเข้าถึง ความอับอายทางสังคม และทรัพยากรผู้เชี่ยวชาญ บทความนี้มีวัตถุประสงค์เพื่อนำเสนอและวิเคราะห์การออกแบบระบบบริการคลาวด์อัจฉริยะเพื่อการสนับสนุนสุขภาพจิต ซึ่งบูรณาการแนวคิดการบำบัดด้วยศิลปะดิจิทัลเข้ากับเทคโนโลยีมนุษย์ดิจิทัลที่ขับเคลื่อนด้วยปัญญาประดิษฐ์ โดยมุ่งสร้างพื้นที่การสนับสนุนทางอารมณ์ที่ไม่ใช่เชิงคลินิก มีเกณฑ์การเข้าถึงต่ำ และเอื้อต่อการมีปฏิสัมพันธ์เชิงอารมณ์อย่างต่อเนื่อง การดำเนินงานใช้กรอบแนวคิดแบบบูรณาการ ประกอบด้วยแนวคิดศิลปะบำบัด ปฏิสัมพันธ์ระหว่างมนุษย์กับคอมพิวเตอร์ ปัญญาประดิษฐ์ และแบบจำลองสิ่งเร้าสิ่งมีชีวิต การตอบสนอง เพื่ออธิบายกลไกที่การออกแบบสิ่งเร้าด้านภาพ เสียง และการตอบสนองของอวาตาร์ดิจิทัลมีผลต่อการกำกับอารมณ์ของผู้ใช้ ระเบียบวิธีวิจัยใช้แนวทางหลายวิธี โดยผสานการทบทวนวรรณกรรม การวิเคราะห์เปรียบเทียบแพลตฟอร์มดิจิทัลที่มีอยู่ การออกแบบระบบต้นแบบเชิงแนวคิด และการประเมินด้านจริยธรรมและความเป็นส่วนตัวของข้อมูล ผลการศึกษาชี้ให้เห็นว่า การผสานเครื่องมือสร้างสรรค์งานศิลปะดิจิทัลเข้ากับอวาตาร์ดิจิทัลที่มีการตอบสนองเชิงอารมณ์แบบหลายโหมด มีศักยภาพในการส่งเสริมการมีส่วนร่วมของผู้ใช้ ลดภาระทางปัญญา และสนับสนุนการแสดงออกทางอารมณ์อย่างปลอดภัย ระบบที่ออกแบบสามารถตอบสนองต่อสภาวะอารมณ์ของผู้ใช้ได้แบบปรับตัว พร้อมทั้งแสดงความเป็นไปได้ในการขยายการใช้งานผ่านโครงสร้างพื้นฐานคลาวด์ที่มีความเสถียรและยืดหยุ่น งานวิจัยนี้เสนอกรอบการออกแบบเชิงระบบสำหรับบริการสุขภาพจิตดิจิทัลที่เน้นความสัมพันธ์เชิงอารมณ์ ความคิดสร้างสรรค์ และความรับผิดชอบทางจริยธรรม โดยมีนัยสำคัญต่อการพัฒนาทางเลือกใหม่ของการสนับสนุนสุขภาพจิตในชีวิตประจำวัน โดยเฉพาะสำหรับผู้ที่มีความทุกข์ทางอารมณ์ระดับเล็กน้อย กลุ่มผู้เปราะบางทางสังคม และผู้ใช้ที่ต้องการพื้นที่การเยียวยาผ่านการสร้างสรรค์

คำสำคัญ: มนุษย์ดิจิทัล, ปฏิสัมพันธ์ทางอารมณ์; ปัญญาประดิษฐ์, คลาวด์คอมพิวติ้ง, ประสบการณ์ผู้ใช้, การออกแบบด้านสุขภาพจิต

Abstract

Amid the rapid advancement of information technology, mental health services face both significant opportunities and challenges in digital transformation. This paper proposes a psychological intelligence cloud service application design that integrates digital art creation with AI-powered digital human technology, aiming to provide users with a non-clinical, creative, and continuous emotional support platform. By combining art therapy concepts, human-computer interaction design principles, natural language processing, and generative AI technologies, we have developed a comprehensive service system encompassing user interfaces, digital creation tools, emotion recognition mechanisms, and digital human interaction modules. The research employs methods such as literature review, existing platform analysis, and conceptual design, emphasizing data privacy compliance, cultural adaptability, and personalized experiences. In terms of evaluation, mixed-methods approaches were used to measure user behavior data and emotional improvement effects, validating the platforms potential in enhancing users psychological well-being. Ultimately, this application demonstrates strong scalability and global applicability for future development, particularly suitable for daily psychological support and emotional expression for individuals

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with mild emotional distress, social impairments, or creative users.
Keywords: digital human, emotional interaction, artificial intelligence, cloud computing, user experience, mental health design

Introduction

Over the past decade, mental health problems have intensified worldwide, particularly among adolescents and working-age populations. According to the World Health Organization, more than one in seven adolescents globally experiences mental health conditions that require care (World Health Organization, 2022). At the same time, over 70% of individuals are unable to access appropriate mental health support due to barriers such as financial constraints, social stigma, and a shortage of mental health professionals (Patel et al., 2023). Within this context, the demand for alternative pathways that enable individuals to access mental health support without direct reliance on clinical professionals has increased significantly.

Digital art therapy has emerged as a promising medium for facilitating emotional expression beyond verbal communication. Previous studies indicate that engaging in art-making activities can reduce anxiety and enhance emotional regulation, even when delivered through digital platforms (Zubala et al., 2021). In parallel, Digital Human technologies or intelligent interactive avatars have increasingly been applied in mental health support contexts, providing functions such as active listening, empathic responses, and motivational reinforcement (Shin & Li, 2023). However, despite these technological advances, most existing platforms in the market still fall short of delivering comprehensive and sustained mental health support.

Despite the growing number of digital applications related to well-being and emotional support—such as Calm, Wysa, Replika, and ZEPETO—each platform remains constrained by specific functional limitations. Existing studies indicate that ZEPETO primarily emphasizes virtual identity construction and online social interaction, yet lacks mechanisms for sustained emotional support or meaningful emotional reflection (Kang & Kim, 2022). DeepThInk demonstrates strengths in AI-assisted artistic co-creation; however, its complex user interface poses significant barriers for users experiencing stress, anxiety, or cognitive fatigue (Wu & Zhao, 2023). Artbreeder, while highly effective in fostering visual creativity, offers minimal emotional companionship or human-like interactive engagement (Chen, 2022). As a result, none of these platforms adequately address the requirements of a cloud-based mental health service that integrates digital art therapy with intelligent avatars to establish continuous, structured emotional relationships.

Market data further confirms that applications combining AI companionship with creative therapeutic interaction remain largely underexplored. A report by Deloitte (2023) reveals that over 80% of mental health applications focus primarily on meditation or cognitive behavioral therapy–based interventions, while fewer than 5% employ art as the foundation of therapeutic interaction. Moreover, less than 1% meaningfully integrate Digital Human technologies capable of sustained emotional interaction. This represents a critical untapped segment in the digital mental health ecosystem, underscoring both the novelty and necessity of the proposed research.

Although extensive research has been conducted on digital mental health services, three major gaps remain insufficiently addressed—gaps that this study seeks to fill.

First, there is a lack of in-depth empirical evidence explaining how the integration of digital art creation and emotionally responsive avatars can support continuous emotional well-being. Previous studies

have primarily focused on isolated activities or short-term interventions, without establishing models for long-term emotional relationships between users and digital agents.

Second, existing digital mental health platforms lack mechanisms for emotional persistence design tailored to vulnerable user groups. Adolescents and older adults, in particular, exhibit dropout rates as high as 40–60% within the first two weeks of usage (Baumel et al., 2019). However, current research has yet to propose a design framework that reduces cognitive burden while sustaining user engagement through creative, emotionally supportive experiences.

Third, most digital mental health services insufficiently address ethical considerations at the design level. Risks related to algorithmic bias, misinterpretation of emotional data in affective recognition systems, and the protection of sensitive personal information are frequently acknowledged in theory but rarely translated into explicit, testable design constraints. These ethical dimensions represent critical challenges that must be embedded into system architecture from the earliest stages of development.

In response to these gaps, this study proposes and evaluates a design framework for an intelligent psychological cloud service that integrates digital art therapy with personalized, multi-modal emotional responses delivered through interactive avatars. Ethical constraints, data privacy, and cultural sensitivity are embedded as foundational design principles, with the system intentionally avoiding the collection of unnecessary sensitive data to ensure that the platform functions as a trustworthy and safe space for users.

This research further tests a set of design-driven hypotheses. Specifically, it hypothesizes that digital art co-creation with emotionally responsive avatars employing multi-modal interaction will lead to a statistically significant increase in positive affect, as measured by the Positive Affect scale of PANAS, after 14 days of use (drawing on findings by Zubala et al., 2021). Additionally, it posits that low cognitive load interface design will significantly increase return usage rates among vulnerable user groups, consistent with usability principles outlined by Yocco (2019). These hypotheses are directly aligned with the research methodology, system evaluation process, and the presentation of empirical findings, forming a coherent and testable research trajectory.

Research Objectives

1) To explore the transformation pathways of art therapy within digital environments, with a particular focus on analyzing how digital avatar technologies enhance emotional engagement and participation.

2) To analyze a comprehensive design framework for intelligent psychological service systems, encompassing user interface design, the configuration of digital art creation tools, and interactive mechanisms for digital avatars.

3) To evaluate the feasibility of technological implementation and the effectiveness of user experience, with the aim of improving overall system usability and performance.

Conceptual Framework / Theoretical Foundations

This study adopts an integrated conceptual framework based on three core pillars: (1) art

therapy and digital art practices, (2) human–computer interaction involving artificial intelligence and digital humans, and (3) the Stimulus–Organism–Response model. Within this framework, multisensory design stimuli and avatar-based feedback mechanisms function as stimuli that influence users' internal emotional regulation processes (organism), leading to observable emotional and behavioral responses. Drawing on principles from digital art therapy and user experience psychology (e.g., Zubala et al.; Yocco), the framework explains how emotionally responsive avatars can support self-regulation, emotional expression, and sustained engagement in digital mental health contexts.

Research Methodology

This study is conducted as design-based qualitative research with a multimethod approach, aiming to integrate theoretical analysis with practice-oriented system design. A multimethod approach in this study refers to the intentional combination of multiple research methods within a single research framework in order to examine the research problem from complementary perspectives. Specifically, it integrates literature-based theoretical inquiry, comparative platform analysis, design prototyping, and ethical evaluation to support both conceptual development and practical validation. This approach is appropriate for research that involves complex interactions between technology, user experience, and psychological processes, where no single method alone can sufficiently capture the research dimensions.

The research process is structured into four main stages.

First, a systematic literature review is conducted to examine prior studies related to digital art therapy, intelligent psychological services, human–computer interaction, digital humans, and emotional design. This stage establishes the theoretical foundation of the study and helps identify key concepts, design principles, and existing research gaps.

Second, a comparative analysis of existing digital platforms is carried out. Three representative platforms—ZEPETO, DeepThInk, and Artbreeder—are selected to represent different design paradigms, including social virtual avatars, AI-assisted creative co-creation, and generative art systems. The analysis focuses on interaction mechanisms, emotional engagement, user interface design, and limitations related to sustained emotional support.

Third, based on insights derived from the literature review and platform analysis, a conceptual prototype of an intelligent psychological cloud service system is developed. This stage focuses on translating theoretical insights into a practical design framework, including user interface structure, digital art creation tools, avatar-based emotional interaction, and cloud-based system architecture.

Finally, an ethical assessment and validation stage is conducted to examine potential ethical risks associated with the proposed system. This includes considerations of data privacy, emotional sensitivity, algorithmic bias, informed consent, and compliance with international data protection regulations.

Data Collection

Data collection in this study is conducted in a step-by-step manner as follows:

1) Document and literature collection

Academic articles, policy reports, and technical documents related to digital mental health, art therapy, AI companions, and user experience design are collected and reviewed to support theoretical analysis.

2) Platform-based comparative data collection

Observational data and design feature documentation are collected from the three selected platforms (ZEPETO, DeepThInk, and Artbreeder), focusing on user interaction flows, emotional engagement

mechanisms, and system functionality.

3) User experience data from prototype interaction scenarios

Users with prior experience using at least one of the selected platforms are invited to engage with simulated interaction scenarios of the proposed prototype. Data are collected through structured observation, user feedback questionnaires, and usage behavior records.

Ethical and risk-related data collection

Information related to user consent processes, data handling mechanisms, and privacy protection strategies is collected to support ethical risk evaluation.

The combination of these data sources enables a comprehensive understanding of both conceptual and practical dimensions of intelligent psychological cloud service design, ensuring methodological rigor and ethical responsibility.

Research Results

The preliminary findings indicate that the interaction between digital art and virtual characters holds significant potential for enhancing psychological well-being. Based on the synthesis of existing research evidence and competitive product analysis, this study identifies key design components and implementation pathways that can inform the development of future intelligent psychological cloud service systems.

Optimization of User Interface Design

Enhancing user interface efficiency emerged as a critical factor. The development of an intuitive, aesthetically pleasing, and multi-device–compatible UI enables users to draw, browse, and interact seamlessly across different terminals. This significantly improves usability and platform attractiveness. In particular, for mobile interaction scenarios, a modular design strategy was adopted to reduce users' initial cognitive load.

Regarding digital art tools, the platform integrates both basic and advanced functional modules. In addition to supporting traditional drawing tools such as pencils, watercolor brushes, and shape-drawing functions, the system incorporates AI-assisted features including style transformation, inspiration generation, and layer management. This dual-layer configuration makes the platform accessible to novice users while simultaneously offering advanced users sufficient space for deep creative exploration.

Design of the Digital Companion System

In designing the digital companion system, the research team developed a prototype capable of multimodal interaction, including text-based chat, voice-recognition dialogue, and virtual video-avatar presentation. The digital human not only provides creative guidance based on user input but also identifies emotional cues to deliver empathetic responses, fulfilling a dual function of emotional support and cognitive guidance. This emotional interaction mechanism integrates natural language processing (NLP)–based sentiment analysis and computer vision (CV)–based facial recognition to monitor users' emotional states in real time. Based on this assessment, the system dynamically recommends creative prompts, relaxation activities, or companion-style conversations tailored to users' current emotional conditions, significantly enhancing the platform's situational responsiveness.

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Cloud Computing and Data Security

Furthermore, the adoption of cloud computing ensures robust performance under high concurrency and stable global accessibility. User data and creative outputs are securely stored and rapidly retrievable worldwide, substantially improving service accessibility and system reliability. In terms of data security, strict compliance with international standards such as the General Data Protection Regulation (GDPR) safeguards user information against misuse or leakage.

1. Design Framework

1.1 User Interface Design

The platform's interface design follows a user-centered philosophy, emphasizing comfort, simplicity, and visual harmony. Soft color palettes—such as blue-green tones and beige-to-white gradients—are employed to create a calm and soothing visual atmosphere consistent with mental health–oriented products

The interface layout adheres to a minimal-interference principle, utilizing smooth animations and clearly defined modular divisions to reduce visual strain and cognitive barriers. Primary navigation is positioned at the bottom of the interface, providing quick access to key functional portals including "Home," "Create," "Interact," and "Personal Center." Users can also customize theme colors and interface styles to support personalized experiences. Gamification elements such as creative achievements, level progression, and daily challenges are incorporated to encourage active participation and sustained engagement.

1.2 Digital Art Creation Tools

The digital art module serves as the core foundation of the platform, catering to both novice and experienced artists. Core tools include multifunctional brushes (e.g., pencil, watercolor, oil paint), color palettes, and intuitive undo/redo functions to ensure creative freedom and precision.

Advanced features leverage AI-driven techniques such as style transfer, enabling artworks to be automatically transformed into styles inspired by artists like Van Gogh or Monet, thereby stimulating new creative inspiration. Additionally, the platform supports real-time collaborative online creation, allowing multiple remote users to share canvases and co-create artworks synchronously. This function enhances the social dimension of creativity and offers practical applications for group counseling or parent–child interaction. A comprehensive instructional resource system—including beginner guides, tutorial videos, and case demonstrations—helps users rapidly develop proficiency with the tools.

1.3 Digital Companion

The digital companion system integrates customizable appearance settings, diverse personality configurations, and multimodal interaction mechanisms. Users may select avatar gender, clothing style, and personality traits (e.g., friendly, humorous, gentle) to align with their psychological needs and communication preferences. Interaction modes include text messaging, voice interaction, and virtual "video call" functions featuring animated avatars, all designed to enhance immersion and emotional connection.

Beyond emotional support, the digital human also functions as a creative advisor. For instance, it may offer specific artistic suggestions during creation (e.g., "Try increasing shadow contrast") or provide comforting feedback when users feel discouraged (e.g., "You seem a bit tired today—would you like to try a lighter creative activity?"). This bidirectional interaction transforms the digital human from a mere tool into an empathetic companion that "understands" the user.

1.4 Emotional Interaction Mechanisms

Emotional interaction mechanisms are centered on identifying, responding to, and guiding users' emotional states. By integrating natural language processing and facial emotion recognition technologies, the platform combines textual expression, vocal tone, and facial cues to automatically assess users' current emotional conditions. Based on this assessment, the system dynamically recommends creative tasks, art therapy activities, or avatar interactions tailored to users' emotional needs.

For example, when stress or anxiety is detected, the system may suggest low-stimulation activities such as static coloring or calming audiovisual content. For users in an active state, more challenging abstract drawing exercises or compositional training may be proposed. The digital avatar also adapts its language style and tone according to the user's emotional state, creating a more intimate and natural companionship experience.

2. Technical Implementation

2.1 Cloud Computing Infrastructure

The stable operation of the intelligent psychological cloud service relies on robust cloud computing infrastructure to ensure high availability and scalability. The platform is deployed on major cloud providers such as Amazon Web Services (AWS) and Google Cloud. A distributed deployment architecture utilizes modules such as Elastic Compute Cloud (EC2) or Google Compute Engine (GCE) to deliver flexible processing capacity, enabling rapid response and automatic scaling during peak usage periods.

For data storage, services such as Amazon S3 or Google Cloud Storage ensure reliable retention of user content, account data, and logs, supporting multi-region backups and high-speed access. This infrastructure facilitates seamless global access and provides strong computational support for frequent backend AI model execution, forming the technological backbone of the platform's real-time intelligence.

2.2 Artificial Intelligence Technologies

The platform's core intelligence is driven by multiple AI technologies. Natural language processing enables text- and voice-based interaction between users and digital avatars, supported by open-source frameworks such as Hugging Face Transformers for contextual understanding and emotion recognition.

In computer vision, OpenCV and TensorFlow are integrated to identify non-verbal cues such as facial expressions and eye movements, enhancing multimodal interaction awareness. The platform also incorporates generative AI technologies, including Stable Diffusion models, which support image style transfer and AI-assisted drawing, allowing users to experience creative inspiration through AI-supported co-creation.

2.3 Data Privacy and Security

Data privacy and security are strategically prioritized throughout technical implementation. The platform employs AES-256 encryption standards to ensure comprehensive data protection during transmission and storage. Strict compliance with international privacy regulations, including the EU's General Data Protection Regulation (GDPR) and the California Consumer Privacy Act (CCPA), defines clear boundaries for data usage and access authorization.

Users can independently manage their data through a "Privacy Center," enabling data export, deletion, and control over AI recommendations. Regular vulnerability scanning and penetration testing are conducted to prevent hacking and data breaches, further enhancing platform trustworthiness and reputation.

3. User Experience and Evaluation

3.1 Evaluation Indicators

To comprehensively assess real user experience, a multidimensional evaluation framework was developed, encompassing behavioral data, emotional change, creative output, and subjective feedback. User engagement, retention, and activity levels were measured through login frequency and average usage duration. Emotional development was analyzed using the Positive and Negative Affect Schedule (PANAS) to compare emotional states before and after platform usage.

Creative output metrics included the number of artworks produced and image complexity per session to evaluate whether AI-assisted creation effectively stimulates creativity. Finally, the Net Promoter Score (NPS) was used to assess overall satisfaction and users' willingness to recommend the platform, supplemented by open-ended questions for qualitative feedback.

3.2 Evaluation Methods

A mixed-method evaluation approach combining quantitative and qualitative methods was employed. Quantitative data were derived from backend log analysis and online surveys, capturing behavioral patterns, emotional trends, and usage preferences. Qualitative insights were obtained through focus group discussions and semi-structured case interviews to explore user experiences and latent needs in depth. This integrated evaluation strategy not only identifies strengths and weaknesses in platform design but also provides actionable references for targeted optimization in future iterations. For instance, user feedback indicating insufficient emotion recognition accuracy or overly mechanical AI suggestions can inform further refinement of AI models and semantic rule systems.

This study proposes an intelligent psychological cloud service platform that integrates art therapy principles with digital human technologies. Supported by cloud computing infrastructure, the platform establishes a non-clinical psychological service system centered on creative expression combined with emotional companionship. It integrates user interface design, AI-based emotion recognition, generative digital art creation, and human–computer interaction mechanisms to explore new technological pathways for mental health intervention. The research findings indicate that the proposed system not only demonstrates technical feasibility but also receives positive user feedback in terms of usability and emotional engagement. Looking ahead, further expansion in areas such as cross-cultural adaptability, AI ethics, and long-term psychological impact assessment may enable intelligent psychological cloud services to become a significant complementary approach to mental health support in the digital era.

Discussion

The intelligent psychological cloud service application developed in this study demonstrates significant innovation and practical potential in both design philosophy and technical implementation. In terms of application, the platform integrates digital art with human-like artificial intelligence to deliver a low-threshold, non-clinical psychological support experience characterized by emotional warmth and accessibility. This approach is particularly valuable for remote communities, socially marginalized groups, and individuals who are reluctant to seek direct professional psychological assistance. The platform shows a high level of user acceptance and applicability. By emphasizing personalized guidance and sustained interaction, it facilitates the development of long-term user relationships, which are conducive to monitoring emotional trends and enabling early psychological intervention.

Nevertheless, several challenges remain. These include limitations in the accuracy of AI-based emotion recognition, concerns regarding user data privacy and trust, and the platform's adaptability across different cultural contexts. For example, users in certain cultural settings may feel uncomfortable expressing negative emotions explicitly, which can interfere with the effectiveness of emotion recognition algorithms. In addition, insufficient transparency in privacy policies may discourage long-term engagement with the platform.

Accordingly, future development should focus on continuous enhancement of the technical infrastructure and on strengthening the contextual and individualized understanding capabilities of digital humans. At the same time, the platform should improve its cultural adaptability and diversify modes of emotional expression within the user interface in order to broaden its user base. Most importantly, from the perspective of AI ethics and social trust, the implementation of explainable AI mechanisms—allowing users to clearly understand how their interaction data are collected, processed, and utilized—will be crucial for increasing transparency, fostering trust, and enhancing the overall credibility of the platform.

Recommendations

To further enhance the platform's usability and its broader social impact, this study proposes the following recommendations. First, future research should explore the application of virtual reality (VR) and augmented reality (AR) technologies in digital art creation and emotionally immersive experiences, as these technologies have the potential to deepen therapeutic engagement and enhance the platform's immersive quality. Second, user education and guidance should be strengthened by helping users better understand the platform's value, functionality, and usage pathways. User retention may be improved through structured online tutorials and case-based demonstrations. Third, the development of multilingual versions is recommended to accommodate diverse cultural backgrounds and linguistic preferences, thereby expanding the platform's global reach. Fourth, continuous optimization of AI algorithms is necessary, particularly with regard to response speed and the degree of personalization, to ensure that digital human feedback can adapt in real time and more effectively reflect users' emotional states.

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