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Construction of AI-Assisted Collaborative Painting-Based Psychological Capital Intervention System

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Abstract: *In recent years, the field of psychology has delved deeper into the study of psychological capital and explored various intervention methods to enhance individual psychological capital. Against this backdrop, AI-assisted collaborative painting technology has emerged as a captivating research direction, finding applications in the construction of psychological capital intervention systems. This paper aims to explore the development of an AI-assisted collaborative painting-based psychological capital intervention system and investigate its potential implications and applications within the domain of psychology. Initially, the paper introduces and elaborates on the concept of psychological capital and its significant role in psychology. Subsequently, the focus shifts to the issue of inadequate psychological capital in modern society, analyzing its underlying causes and its impact on individual psychological well-being and adaptability. Following that, the paper provides a detailed account of the principles and technical key points involved in constructing an AI-assisted collaborative painting-based psychological capital intervention system. The system will leverage data collection and analysis, real-time emotion recognition technology, and personalized intervention strategies to offer users individualized emotional recognition and intelligent intervention, aiding them in strengthening self-efficacy, fostering optimism, and igniting hope. Consequently, users will be better equipped to confront the challenges posed by modern society.*

Keywords: *Artificial Intelligence; Painting Therapy; Psychological Capital; Deep Learning; CNN*

1. Introduction

With the continuous advancement and application of artificial intelligence (AI) technology, its astonishing potential and value have been demonstrated across various domains. Among these, the innovative field of psychological capital intervention systems has been garnering increasing attention within the realm of psychology. Psychological capital refers to the positive psychological resources individuals possess to cope with various challenges and pressures in life, encompassing elements such as self-confidence, optimism, hope, and resilience[1]. It plays a crucial role in promoting individual psychological well-being, enhancing adaptability, and increasing job and life satisfaction[2-4].

However, contemporary society is confronted with increasingly complex and dynamic challenges and pressures, such as intense job competition, intricate interpersonal relationships, and a rise in psychological health issues, leading to a widespread decline in psychological capital levels. This dearth of psychological capital may give rise to numerous negative consequences, including emotional disorders, anxiety, depression, and social difficulties[5-7]. Consequently, the need to elevate individual psychological capital levels has become an urgent and pressing matter in need of resolution.

In the present context, the application of artificial intelligence (AI) has introduced novel perspectives and solutions to the field of psychology. Particularly, the construction of psychological capital intervention systems based on AI-assisted collaborative painting has emerged as a prominent research focus. This system uniquely combines artistic creation with psychological intervention, harnessing AI technology to foster and enhance individual psychological capital. In 2018, Cooney & Menezes[8] designed a simplified prototype robot to assess and interpret trends in artwork and gauge artists' personal interests and knowledge levels. In 2022, Seo et al.[9] devised an art therapy-assisting

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tool, primarily focused on painting therapy, to enhance fairness and efficiency in online art therapy. In 2021, Kim et al.[10] employed deep learning techniques for understanding and analyzing artwork.

This paper aims to delve into the research significance, current status, and potential prospects of constructing an "AI-Assisted Collaborative Painting-Based Psychological Capital Intervention System." Initially, we will introduce the concept of psychological capital and its pivotal role in the field of psychology, elucidating the prevailing issue of inadequate psychological capital. Subsequently, we will examine the current state of artificial intelligence technology's application in psychology, with a particular focus on intervention methods based on collaborative painting. Following that, we will explore the principles and technical key points involved in constructing this system. Finally, we will provide an outlook on the future development prospects of the system while also acknowledging potential challenges and limitations that may be encountered.

By conducting in-depth research on the construction of an "AI-Assisted Collaborative Painting-Based Psychological Capital Intervention System," we anticipate contributing novel perspectives and methodologies to the advancement of the field of psychology. Leveraging the power of artificial intelligence technology, we can more efficiently and individually cultivate and enhance individuals' levels of psychological capital, thereby promoting psychological well-being, improving the quality of life, and making a positive contribution to the development and progress of society.

2. Related Works

Psychological capital refers to the positive psychological resources individuals possess to cope with various challenges and pressures in life, encompassing four key elements: self-efficacy, optimism, hope, and resilience. Within the field of psychology, psychological capital plays a vital role. Firstly, psychological capital exerts a positive impact on an individual's psychological well-being. Self-efficacy instills the belief in one's ability to tackle challenges, optimism fosters a more positive approach to life's uncertainties, hope motivates individuals to persevere in pursuing their goals, while resilience enables greater adaptability and toughness in the face of adversity[1]. These psychological resources collectively contribute to reducing negative emotions such as anxiety and depression, and elevate psychological well-being and life satisfaction[4]. Secondly, psychological capital is critical for an individual's adaptability and ability to cope with stress[3]. Modern society presents various challenges and changes, demanding individuals to possess strong adaptability. Psychological capital equips individuals with the capacity to confront complex and evolving environments and facilitates better coping with challenges and stressors. Individuals with psychological capital are inclined to proactively respond to changes, enhancing their ability to adapt to social and work environments. Thirdly, psychological capital exhibits close associations with job performance and innovation capability. Individuals with higher psychological capital are more motivated in their work endeavors and are more likely to achieve outstanding performance and demonstrate innovative behaviors[11].

However, the current society faces the issue of insufficient psychological capital, as the fast-paced, high-pressure, and information-rich environment of modern society imposes significant psychological burdens on individuals, leading many to grapple with challenges of inadequate psychological capital[12, 13]. Such deficiencies in psychological capital may result in individuals experiencing emotional distress, encountering psychological health issues, and affecting their performance in both work and personal life. To address the prevalent problem of insufficient psychological capital, psychologists and researchers need to explore effective intervention approaches. The construction of an AI-assisted collaborative painting-based psychological capital intervention system could offer an innovative solution. Leveraging artificial intelligence technology, this system has the potential to provide individuals with personalized avenues for cultivating psychological capital, assisting them in enhancing self-efficacy, fostering optimism, igniting hope, and increasing resilience. In turn, this could better equip individuals to confront the challenges of modern society, promoting their psychological well-being and overall development.

Previous studies have already begun to explore the utilization of artificial intelligence for the toolifiction and platform construction of art therapy, but there are still limitations. In 2018, Cooney & Menezes[8] introduced a simplified version of an art therapy robot designed to comprehend human taste and knowledge levels. The robot attempted to produce drawings and compare them to human artwork, as depicted in Figure 1. From Figure 1, it is evident that the art therapy robot exhibits considerable disparity compared to human artwork, only displaying traces of imagery in localized regions.

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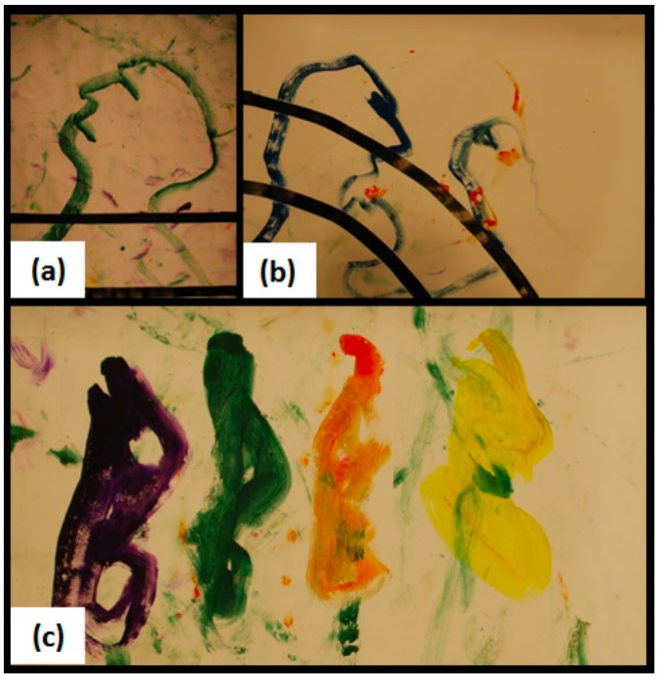

Figure 1: A simplified version of the art therapy robot painting[8]

Additionally, the painting therapy assisting tool designed by Seo et al. in 2022[9] was specifically tailored for the "House-Tree-Person" (HTP) test scenario, as illustrated in Figure 2. Through comprehension of the artwork, artificial intelligence can recognize concepts such as "House-Tree-Person." However, since the artwork requires prior preparation by the visitors, it cannot achieve real-time online responsiveness to the visitors.

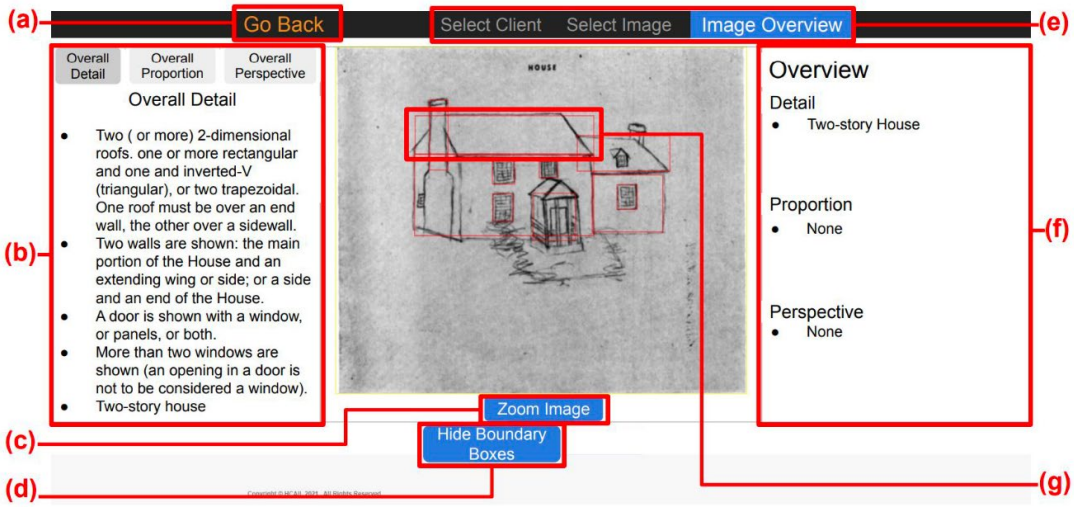

Figure 2: The auxiliary tool for painting therapy[9]

Last but not least, in 2021, Kim et al.[10] utilized deep learning techniques to provide a textual summary of the HTP artwork, yet it still lacks the capability for real-time psychological counseling to visitors. Therefore, from the perspective of art therapy, there is a need for an intelligent system that can gather user art therapy data, such as drawing works and relevant emotional information, in real-time. By constructing visitor profiles and summarizing historical data, this intelligent system should be capable of offering relevant intervention suggestions.

3. System Construction

This section primarily expounds on the principles and technical key points involved in constructing an AI-assisted collaborative painting-based psychological capital intervention system, along with the

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user process and data flow.

3.1. Principles and Technical Key Points

The construction of an AI-assisted collaborative painting-based psychological capital intervention system is an innovative approach that combines artificial intelligence technology with artistic creation. Its primary objective is to personalize the cultivation and enhancement of individual psychological capital to strengthen psychological well-being and adaptability. The following are the principles and technical key points involved in building this system:

- Data Collection and Analysis: The system initially gathers psychological capital-related data from individuals through various means, including assessments of self-efficacy, optimism, hope, and resilience, as well as emotional and behavioral responses to challenges and stressors. These data can be obtained through psychological measurement questionnaires, emotion recognition technologies, biometric sensors, and other methods. The system employs artificial intelligence algorithms to analyze and process this data, gaining in-depth insights into individuals' psychological states and capital levels.
- Integration of Artistic Creation and Psychological Intervention: The system utilizes painting art as a medium to combine psychological intervention with artistic creation. Painting is widely employed in psychotherapy and intervention as it enables individuals to express emotions, explore their inner world, and enhances the cultivation of psychological capital. Through their artwork, individuals can showcase their inner feelings, express their aspirations for the future, and demonstrate resilience and hope in the face of adversity. The emotional release and introspection during the drawing process contribute to stimulating individuals' inherent positive resources.
- Emotion Recognition and Emotion Regulation: The system leverages artificial intelligence's emotion recognition technology to analyze and identify emotions manifested in individuals' drawing artworks. Through image processing and emotion recognition algorithms, the system accurately captures the emotional content embedded within the drawings. Additionally, the system is equipped with an emotion regulation module, which provides relevant emotion regulation advice based on the emotions expressed in the individuals' artworks, aiding them in better understanding and managing their emotions.
- Personalized Intervention Strategies: Based on individuals' levels of psychological capital and the emotional expressions in their drawing artworks, the system can intelligently devise personalized psychological capital intervention strategies. For instance, for individuals with insufficient self-efficacy, the system can offer relevant affirmations and encouragement, while for those lacking optimism, it can provide advice for cultivating a positive mindset. These personalized intervention strategies aim to enhance individuals' psychological capital and assist them in better coping with life's challenges and stressors.
- Feedback: The system also offers real-time feedback and monitoring. Individuals can access their drawing artworks and the corresponding emotional analysis results at any time, receiving targeted intervention advice. The system can also record the developmental trajectory of individuals' psychological capital, utilizing data analysis and algorithms to predict trends in individuals' psychological changes, facilitating more effective interventions.

With the aforementioned principles and technical key points, the AI-assisted collaborative drawing-based psychological capital intervention system can offer personalized, emotion recognition, and intelligent intervention approaches, promising to provide innovative and effective support for cultivating and enhancing individuals' psychological capital. Concurrently, the advancement of such a system also contributes to the promotion and development of artificial intelligence technology within the field of psychology.

3.2. User Process

In the AI-assisted collaborative painting-based psychological capital intervention system, users initially access the system, and the system presents the homepage. Subsequently, users select the "Start Painting" function, entering the drawing interface. Within the painting interface, users express their inner feelings and emotions through their drawing artworks. Following this, the system utilizes emotion recognition technology to conduct in-depth analysis of the emotional content within the drawing artworks. Utilizing intelligent emotion analysis results, the system devises personalized psychological

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capital intervention strategies. The formulation of these intervention strategies aims to assist users in better coping with challenges and stressors.

The system provides users with emotion regulation advice, encouraging and motivating them to actively confront life's challenges. Users can cultivate their psychological capital based on the advice provided by the system, gradually elevating their level of psychological resources. Simultaneously, the system records users' developmental trajectory of psychological capital and conducts profound analysis and predictions of their psychological trends.

Users can access their drawing artworks and emotion analysis results at any time within the system, and make adjustments based on the targeted intervention advice. They can continuously engage in the painting and psychological capital intervention cycle within the system, gradually enhancing their psychological well-being and adaptability. Through this iterative process, individuals will continually improve self-awareness, enhance emotion regulation abilities, and proactively face various challenges in life. This AI-assisted collaborative painting-based psychological capital intervention system provides users with personalized avenues for cultivating psychological resources, aiming to promote psychological well-being and overall development, as depicted in Figure 3.

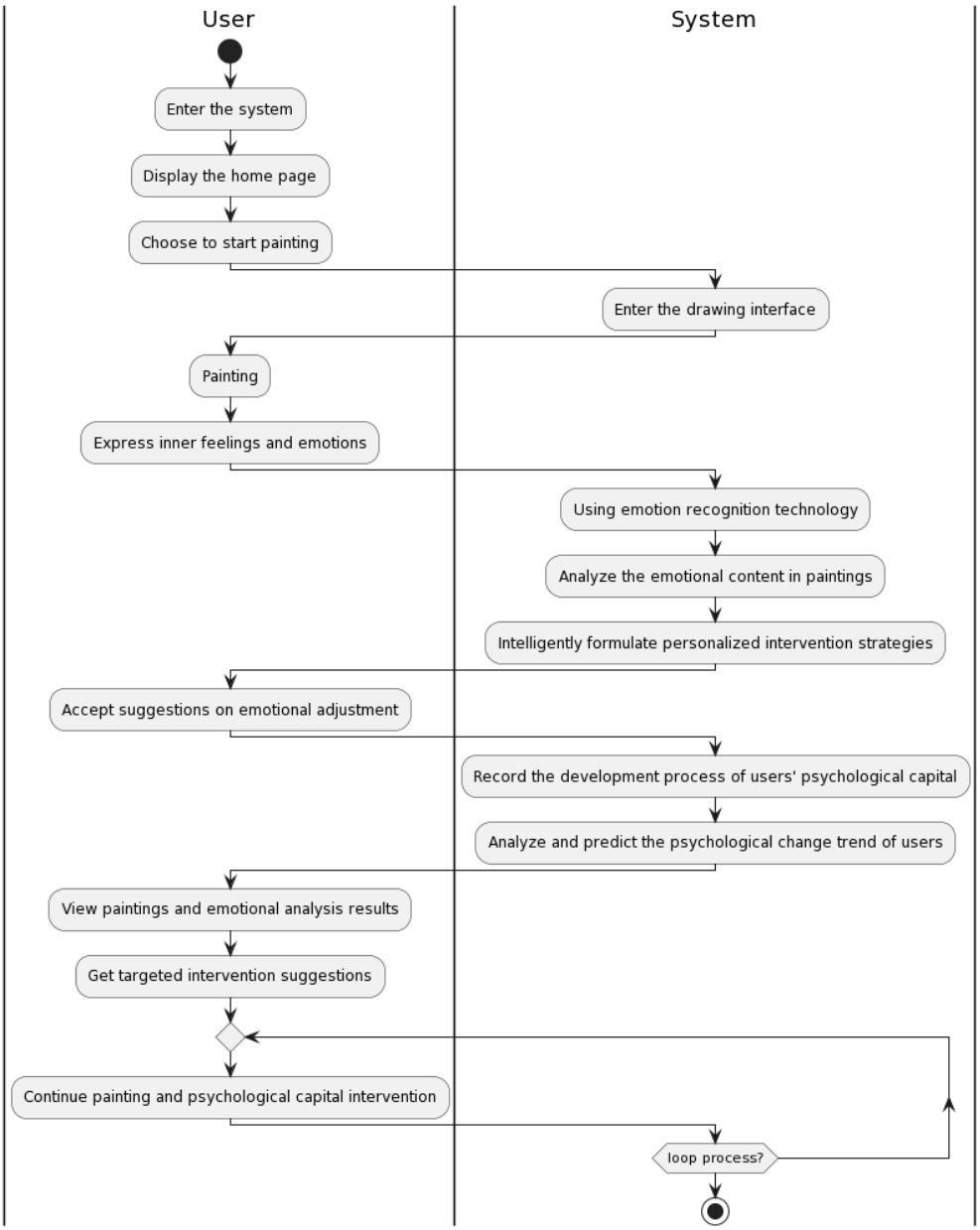

Figure 3: User Flow Chart

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3.3. Data Flow

The AI-assisted collaborative drawing-based psychological capital intervention system generates the following data:

- User login information: This includes the user's username and password, used for identity authentication when logging into the system.
- Painting data: This data encompasses the artworks created by the user within the drawing interface and may be stored in the form of images or other formats.
- Emotion analysis results: These results are obtained through emotion recognition and analysis of the drawing data. They may include information such as the types and intensities of emotions expressed in the artworks.
- Intervention strategies: Based on the emotion analysis results, the system devises personalized psychological capital intervention strategies intelligently to enhance the user's psychological capital.
- Intervention recommendations: Based on the intervention strategies, the system generates targeted intervention recommendations, providing users with advice for emotion regulation and psychological capital cultivation.
- User psychological capital developmental trajectory: The system records users' changes in psychological capital during the drawing and intervention process, which is utilized for analysis and prediction of users' psychological change trends.
- By utilizing the data generated by the system and incorporating the user process, a data flow diagram can be structured, as depicted in Figure 4.

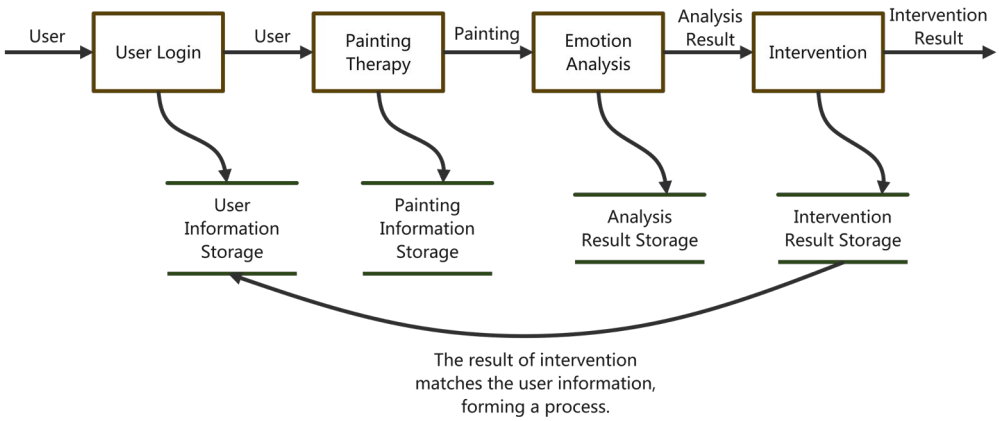

Figure 4: Data Flow Chart

4. Discussion and Conclusion

The AI-assisted collaborative painting-based psychological capital intervention system is an innovative intervention method that integrates artificial intelligence technology with artistic creation. Its primary goal is to cultivate and enhance individuals' psychological capital to strengthen their psychological well-being and adaptability. This paper explores the principles and technical key points involved in building this system and demonstrates its significant role in the field of psychology.

Firstly, the system's strength lies in its combination of artificial intelligence technology and the characteristics of artistic creation, providing a novel approach to cultivate psychological capital. Through emotion recognition technology, the system can deeply analyze the emotional content within individuals' drawing artworks, thereby devising more precise personalized intervention strategies. Moreover, through artistic expression in painting, individuals can present their inner feelings and emotions, fostering self-awareness and stimulating inherent positive resources. As a result, the system not only offers intelligent intervention strategies but also provides a means of emotional release and introspection, thereby adding depth and personalization to psychological interventions.

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Secondly, one of the key features of this system is its personalized intervention strategies. Traditional psychological intervention methods are often more generalized, lacking consideration for individual differences. However, the AI-assisted collaborative painting system can intelligently devise personalized intervention strategies based on individuals' emotion recognition results, tailoring the interventions to each person's specific needs. This personalized approach enhances the specificity and effectiveness of the interventions. Additionally, the system maintains the continuity of psychological capital cultivation by continuously recording users' developmental trajectory of psychological capital, thereby enhancing the stability and sustainability of the psychological capital development process.

The construction of an AI-assisted collaborative painting-based psychological capital intervention system is a cutting-edge and promising research area. By integrating artificial intelligence technology with artistic creation, this system offers an innovative solution for psychological capital intervention. The system's personalized intervention strategies and emotional expression function provide advantages that traditional psychological intervention methods lack.

5. Limitations and Future Research

The system also faces some challenges and limitations. Firstly, the accuracy of emotion recognition technology is crucial for the success of the system. Currently, emotion recognition technology still encounters issues such as low recognition accuracy and insufficient understanding of emotional complexity. If the emotion analysis results contain errors, the precision of intervention strategies may be compromised, impacting the effectiveness of interventions. Secondly, the establishment of personalized intervention strategies in the system relies on a significant amount of individual data and algorithm optimization. Protecting user privacy and data security poses a significant challenge in ensuring the privacy and security of user data during system operation.

In the future, further optimization of emotion recognition technology can be pursued to enhance its accuracy. Additionally, integration with other advanced technologies such as natural language processing can help improve the understanding of emotional complexity. Concurrently, strengthening measures to protect user data privacy is essential to ensure data security and controllability within the system. Further research and practical implementations hold the potential to advance the system's development, providing the field of psychology with more intelligent and personalized intervention methods, ultimately promoting the enhancement and comprehensive development of individuals' psychological well-being.

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