Optimization of Human-computer Interaction in Computer Aided Design System Based on User Behavior and Design Psychology

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Abstract. The wide application of computer aided design (CAD) greatly improves the design efficiency, reduces the workload of engineers, and opens up a broader design possibility. Traditional CAD systems tend to focus on the completion of tasks, while ignoring the behavior and psychological needs of users in the process of use. In this article, an interactive optimization strategy of CAD system based on user behavior and design psychology is proposed, and the human-computer interaction (HCI) experience of the system is analyzed by combining the user emotion classification model based on support vector machine (SVM). By comparing the results of user emotion classification before and after optimization, the effect of optimization strategy can be objectively evaluated and quantitative emotional experience feedback can be provided for users. Judging from the scoring results, the optimized CAD system has excellent interface comfort, convenient operation and image processing effect. By continuously optimizing the HCI experience, it is helpful to reduce the design cost, reduce the number of design iterations, and further promote the innovation and application of design. Designers will enjoy higher image quality, smoother operation experience and less design errors when using the optimized CAD system.

Keywords: User Behavior; Design Psychology; Computer Aided Design; Human-Computer Interaction
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1 INTRODUCTION

CAD system plays a vital role in modern engineering design. With the continuous progress of technology and the rapid development of computer technology, CAD system has evolved from a simple two-dimensional drawing tool to a powerful three-dimensional modeling and simulation system. Mobile based emotion recognition technology, especially research on emotion recognition through speech and heart rate data, has enormous potential. This technology can be used to improve human-computer interaction, mental health monitoring, and decision support for individuals and teams. Alshaibani et al. [1] explore the design and implementation of mobile human emotion recognition technology based on speech and heart rate. Many researchers are committed to identifying human emotional states by analyzing and understanding human speech and heart rate data. For example, speech analysis is used to detect emotional states, including happiness, sadness, anger, etc. Meanwhile, the analysis of heart rate variability was also found to be related to emotional states. However, most of these studies only focus on one or two emotional states, and most have not yet developed into practical applications. The experimental results show that the system can effectively recognize different emotional states, with an accuracy rate of over 90%. Meanwhile, user feedback indicates that the system helps to better understand and monitor one's emotional state. The experimental results indicate that the system has high accuracy and user satisfaction, and has important application value and development prospects. Future research directions include optimizing algorithms, improving accuracy, expanding application scope, and exploring more methods for identifying emotional states. Its wide application has greatly improved the design efficiency, reduced the workload of engineers, and created a broader design possibility. However, the traditional CAD system often pays attention to the completion of tasks, ignoring the behavior and psychological needs of users in the process of use. With the continuous development of digital music technology, the scale and complexity of music data are also increasing. In order to better manage and use these music data, the computer-aided design system for music automatic classification based on feature analysis has gradually been widely applied. However, existing systems still have some problems, such as low classification accuracy and slow processing speed. Therefore, Ge et al. [2] explored how to optimize a computer-aided design system for music automatic classification based on feature analysis. A series of effective optimization methods have been proposed through optimization research on the computer-aided design system for music automatic classification based on feature analysis. The experimental results show that the optimized system adopts more effective feature extraction methods and powerful classifiers, resulting in a significant improvement in classification accuracy. Specifically, the optimized system has improved the accuracy of music classification tasks by about 10% compared to the original system. The optimized system adopts parallel computing and caching technology, which significantly improves processing speed. Specifically, the optimized system can process the same amount of music data approximately 30% faster than the original system. This provides new ideas and methods for the research and application of music automatic classification. In the future, we will continue to conduct in-depth research on related technologies for music automatic classification, providing more support for the development of the music industry.

Therefore, how to optimize the HCI of CAD system and improve the user experience and efficiency has become an urgent problem. The research field of HCI began to shift from task-centered design to user-centered design. Social space comfort refers to the level of comfort that people experience in a specific social space. This not only includes physical environmental factors such as temperature, humidity, and light, but also involves people's social behavior, interaction, and psychological state. In the process of human-computer interaction, social space comfort is of great significance for improving user experience and promoting effective human-computer interaction. Visual based analysis methods utilize image and video data to extract information about people's behavior, emotions, and interactions in social space. Through technologies such as computer vision and deep learning, we can analyze and interpret people's facial expressions, body language, and group behavior. This information plays an important role in understanding people's experiences and needs in human-computer interaction. User centered human-computer interaction design emphasizes attention to user needs and experiences. Lee et al. [3] used visual analysis methods to better understand users' behavior, emotions, and interactions in social space, thereby designing human-machine interaction interfaces and methods that better meet user needs and improve user experience. In addition, these data can also be used to evaluate the effectiveness of human-computer interaction and provide a basis for optimizing design. This change pays more attention to users' needs and experiences, and devotes itself to studying the characteristics of users' behavior, cognition and emotion during use. Based on the theory of user behavior and design psychology, it can provide researchers with methods and tools to deeply understand user needs. The basic principle of a CAD system is to establish a three-dimensional model of a product, perform various operations and analyses on the model, and thus complete the design and optimization of the product. Designers can use CAD systems to zoom in, out, rotate, and mirror product models, as well as edit and adjust materials, colors, textures, and other aspects of the model. In addition, CAD systems can also perform advanced analysis such as finite element analysis and dynamic simulation, providing more support for product optimization and innovation. Through CAD systems, designers can design and innovate products more efficiently, while also better controlling the quality and performance of products. Li and Li [4] discussed the research and application of computer-aided design systems in product innovation. Designers can quickly create and modify 3D models of products through CAD systems. This allows designers to try multiple design schemes in a short period of time and choose the best design scheme for in-depth design and optimization. The CAD system can also provide support for production preparation. For example, using the CAM function of CAD systems, machining codes can be generated and directly used for programming and controlling production equipment. In addition, CAD systems can also simulate and optimize the production process, thereby improving production efficiency and product quality. By analyzing the user's behavior, we can reveal the actual operation of the user in the CAD system and find out the potential problems and bottlenecks. At the same time, design psychology can help us understand the psychological process and emotional experience of users, so as to design an interactive interface and operation process that is more in line with the user's mental model.

The reactive emotional expression of natural dialogue based on multimodal emotion recognition has gradually attracted the attention of researchers. This technology aims to enable machines to interact more naturally with humans and express corresponding emotional responses by recognizing and understanding their emotional states. Li et al. [5] provided a detailed introduction to this natural dialogue reactive emotion expression technology based on multimodal emotion recognition. Human emotional states can be identified by analyzing modal particles, keywords, and features such as pitch and volume in speech in the text. At the same time, more complex emotional states can also be identified by analyzing the subtle changes in facial expressions. This multimodal emotion recognition technology can more accurately understand and express human emotional states, providing strong support for reactive emotional expression in natural dialogue. Reactive emotional expression in natural dialogue refers to the ability of machines to automatically express corresponding emotional responses based on the emotional state of the conversation content. This technology aims to enable machines to naturally express emotions during interaction like humans, in order to improve the experience of human-computer interaction. To achieve reactive emotional expression in natural dialogue, it is necessary to combine multimodal emotion recognition with natural language processing technology. Especially in the field of design, the introduction of AI not only changes traditional creative methods, but also provides new possibilities for human-computer interaction (HCI). Liao et al. [6] explored how artificial intelligence enhances design support frameworks and analyzed the human-machine interaction within them. Human computer interaction plays a crucial role in designing support frameworks. On the one hand, designers need to understand and utilize the suggestions and optimization solutions provided by AI through human-computer interaction. On the other hand, designers also need to adjust and optimize the design process through human-computer interaction to meet practical needs. In addition, human-computer interaction also provides designers with the possibility of creating in areas that AI cannot cover. Designers will rely more on AI for creation and decision-making, and AI will also have a deeper understanding of the designer's needs and intentions. Meanwhile, with the advancement of human-computer interaction technology, designers will be able to interact with AI more naturally and intuitively, thereby further improving design efficiency and creative quality. The artificial intelligence enhanced design support framework has brought revolutionary changes to the design field. Through the bridge effect of human-computer interaction, AI and designers have jointly created more innovative and efficient design solutions.

The research goal is to put forward an HCI optimization strategy for CAD system by combining the theory of user behavior and design psychology. This article will deeply analyze the HCI problem in CAD system and discuss its influence on user experience and efficiency. On this basis, the related theories and methods of user behavior and design psychology are applied to the HCI design of CAD system. Through reasonable interface design, optimization of interaction mode and introduction of intelligent functions, it is expected to improve the usability, learning and user satisfaction of CAD system and reduce the cognitive load and physical load of users. In order to verify the effectiveness of the proposed optimization strategy, this study will make an empirical analysis based on SVM-based user emotion classification model. The model can evaluate the HCI experience quality of the optimized CAD system by classifying and identifying user emotions. By comparing the results of user emotion classification before and after optimization, the effect of optimization strategy can be objectively evaluated and quantitative emotional experience feedback can be provided for users. The main innovations of this study are:

(1) This article combines user behavior and design psychology to conduct HCI optimization research on CAD systems. Through in-depth analysis of user behavior, it is possible to more accurately understand the needs and pain points of designers in the actual operation process, and provide targeted solutions for the optimization of CAD systems.

(2) This article proposes a HCI optimization strategy for CAD systems based on user behavior and design psychology. This strategy comprehensively considers the user's behavioral habits, psychological needs, and principles of design psychology. By improving the interaction interface, operation process, and intelligent functions, it enhances the usability, learning ability, and user satisfaction of CAD systems.

(3) This article introduces an SVM based user sentiment classification model for analyzing and evaluating the HCI experience of optimized CAD systems. By quantitatively evaluating user emotions, the effectiveness of optimization strategies can be objectively measured, providing users with more specific and intuitive feedback.

(4) The proposed HCI optimization strategy can be applied to other similar HCI design fields, promoting the development and innovation of the engineering design field. At the same time, the SVM based user sentiment classification model can also provide reference and reference for the assessment of other HCI designs.

This article first points out the necessity of HCI experience optimization in CAD systems, outlines the main work and research objectives; Then briefly describe the relevant theories of user behavior and design psychology; Next, we will introduce optimization methods and techniques, as well as how to construct a user sentiment classification model based on SVM algorithm; Finally, evaluate the effectiveness of the algorithm in optimizing the HCI experience of CAD systems, and summarize the research work and achievements.

2 THEORETICAL BASIS

With the expansion of enterprise scale and the complexity of equipment, equipment management has become an important link in enterprise operation. The design and implementation of equipment management information systems can effectively improve equipment management efficiency, reduce maintenance costs, and ensure the stable operation of equipment. Liu and Li [7] introduce the design and implementation of a computer-aided equipment management information system. The system adopts a relational database and designs corresponding data tables to store equipment information, maintenance records, fault reports, and other information. The system adopts a graphical user interface, which is convenient for users to operate. The interface includes login interface, main interface, device information management interface, maintenance management interface, fault repair management interface, data analysis and report generation interface, etc. Based on requirement analysis, write corresponding program code to implement various functions of the system. During the system implementation process, attention needs to be paid to ensuring the confidentiality, integrity, and availability of data. Ensure the stable operation of the system and avoid system crashes or data loss caused by abnormal situations. Ensure the maintainability of the system and facilitate future upgrades and maintenance of the system. Medjden et al. [8] designed an automatic UI adaptive framework for multimodal emotion recognition based on RGB-D sensors. This framework can automatically adjust the UI to better meet user needs and provide a more personalized and comfortable user experience by analyzing users' emotional states. In the past few years, research on UI adaptation based on emotion recognition has gradually received attention. These studies mainly rely on techniques such as text analysis, speech recognition, or facial expression analysis to infer users' emotional states. However, these methods usually only consider a single emotion recognition pattern, ignoring the complexity and variability of emotional states. To address this issue, we propose a multimodal emotion recognition method that can simultaneously utilize RGB and depth information to identify users' emotional states. Automatically adjust UI elements such as color, layout, and interaction based on the identified user emotional state. For example, when users appear tired or anxious, the UI can automatically adjust to quieter and more relaxed colors and layout. When users are happy or excited, the UI can be adjusted to more active and enthusiastic colors and layouts. The experimental results show that our multi-mode emotion recognition method can recognize the user's emotional state more accurately, and has higher accuracy and lower false positive rate than the single mode emotion recognition method. Meanwhile, our UI adaptive framework can automatically adjust the UI under different emotional states, making the user experience more comfortable and personalized.

With the development of technology, especially the advancement of human-computer interaction (HCI) technology, personalized health applications have played an increasingly important role in cardiovascular health management. Quazi et al. [9] will provide a systematic review of the latest research on personalized health applications for optimizing cardiovascular health through HCI technology. Personalized health applications refer to applications that provide customized advice and interventions on an individual's health status and lifestyle. In a systematic review, researchers analyzed 30 related studies covering various aspects of personalized health applications for optimizing cardiovascular health through HCI technology. The results indicate that these applications have certain effects in improving cardiovascular health indicators and quality of life, but the effects may vary among different populations and environments. Although existing research has shown that personalized health applications for optimizing cardiovascular health through HCI technology have certain effects, there are still many issues that need further research and exploration. In an important paper published in the ACM Journal of Human Computer Interaction, researchers delved into the roles of designers and artificial intelligence (AI) in design and collaboration. Shi et al. [10] conducted a comprehensive systematic literature review on the design collaboration between designers and AI, revealing the mutual influence and interaction between the two in the joint design process. In the past few years, AI technology has made significant progress and had a profound impact in many fields, especially in the design field. The collaboration between designers and AI has become an important research field, and researchers have conducted extensive research on it. This paper provides a systematic review and summary of past research, proposing a comprehensive theoretical framework for understanding the interaction and influence between designers and AI in design collaboration. The interaction and influence between designers and AI are complex and multidimensional. AI can provide data analysis and prediction results, but the final design decision is still made by the designer. Designers can improve the performance and performance of AI by providing feedback and guidance.

Building hazard identification is an important link in ensuring building safety. With the development of technology, the application of Human Computer Interaction (HCI) in building hazard identification has gradually attracted the attention of researchers. Wang et al. [11] summarized the development trend of human-computer interaction research in building hazard identification from the perspective of bibliometrics and combined with sensor technology. Sensor technology is one of the important means to achieve human-computer interaction. In building hazard identification, sensors can be used to monitor the structural status and environmental factors of buildings, providing real-time data for hazard prediction and warning. Although the application of human-computer interaction in building hazard identification has achieved certain results, there are still some challenges and problems. Firstly, how to improve the intelligence and automation of human-computer interaction, so that computers can more accurately understand and process dangerous information, is an important research direction in the future. Secondly, how to integrate sensor technology with human-machine interaction to achieve more efficient and real-time hazard monitoring and warning is also a challenging issue. In addition, how to ensure the reliability and security of sensor networks, prevent malicious attacks and data leakage, is also a problem that needs to be paid attention to. With the continuous development of CAD (Computer Aided Design) technology, the application of CAE in product design is also becoming increasingly widespread. However, the complexity and diversity involved in CAE make its application difficult and cumbersome. Therefore, Wolf et al. [12] proposed a simplified CAE method, which is a user product interaction modeling framework in CAD based on basic availability classification. Basic availability refers to the functionality and performance that a product or system possesses to meet user needs in a specific environment. According to the different characteristics of the product, basic availability can be divided into the following categories: operational availability, functional availability, information availability, and physical availability. Operational availability refers to the physical and cognitive requirements of a product during operation. Functional availability refers to the functions and performance that a product should possess. Information availability refers to the information and feedback that a product should provide to users. Physical availability refers to the physical characteristics such as appearance and size of a product. Xiong [13] explores how to use human-computer interaction and auxiliary interaction technology to build such a new physical education teaching system and training framework. Human computer interaction technology provides new possibilities for physical education teaching. By using smart devices and applications, teachers can better understand students' sports activities and health status, in order to provide personalized guidance. In addition, human-computer interaction technology can also be used to create training environments for virtual reality (VR) and augmented reality (AR), allowing students to practice and improve their skills in simulated real scenes. By combining human-computer interaction and auxiliary interaction technology, we can construct a brand new physical education teaching system and training framework. Under this system, students can engage in personalized learning and training through intelligent devices and applications. Teachers can provide personalized guidance and feedback by monitoring students' movement data and performance in real-time. In addition, the new training framework can also include online evaluation and feedback systems, allowing both students and teachers to easily view and understand students' training progress and performance.

With the rapid development of information technology, the design and application of teaching systems have increasingly relied on computer-aided design (CAD) technology. CAD technology can not only improve the design efficiency of teaching systems, but also achieve personalized recommendations through data analysis and recommendation algorithms to meet the needs of different students and improve teaching quality. Xu [14] explores the concept, application, and future development trends of computer-aided design for personalized recommendations in teaching systems. Through CAD software, teachers can easily create and edit course materials, simulate experiments, and interactive games. At the same time, students can engage in self-learning, collaborative learning, and practical operations through the CAD platform to improve learning effectiveness. In addition, CAD technology can also achieve personalized recommendations through data analysis and recommendation algorithms, providing students with more accurate learning resources and services. Personalized recommendation is a user centered service model that provides personalized suggestions and resources to users by analyzing their needs and behaviors. In teaching systems, personalized recommendations can help teachers better understand students' learning needs and interests, thereby providing more accurate teaching content and resources. Zhang et al. [15] The combination of adaptive user interfaces and adaptive user interfaces provides a new solution for improving the usability and user performance of complex user interfaces. Adaptive user interface is a type of user interface that can automatically adjust the layout and functionality of interface elements based on user behavior and needs. It can dynamically adjust interface elements based on user operating habits, preferences, and task requirements, as well as real-time monitoring of user behavior by the system, to provide a more personalized and efficient user experience. Although significant progress has been made in adaptive user interfaces, in practical applications, a single adaptive user interface often cannot meet all user needs and scenarios. Therefore, combining different adaptive user interfaces to provide a richer and more flexible user experience has become a new research direction. For example, a rule-based adaptive user interface and a learning based adaptive application user interface can be combined to improve the usability and user performance of the interface by utilizing the certainty of rules and the efficiency of learning. With the popularity of social media and mobile devices, the number and types of user generated videos (UGCs) have significantly increased in recent years. These videos cover a wide range of themes and emotions, providing rich data resources for emotional analysis. However, emotional recognition of UGC videos remains a challenge as they typically contain complex sound, visual, and emotional information. To address this issue, Zhao et al. [16] proposed an end-to-end visual audio attention network for UGC video emotion recognition. Traditional emotion recognition methods typically rely on text or speech analysis, which has limitations when dealing with UGC videos. Deep learning has made significant progress in image and speech recognition, but it still faces challenges in simultaneously processing visual, audio, and emotional information. Some studies attempt to combine visual and audio information for emotion recognition, but they often overlook the importance of emotional information or do not provide end-to-end training for all information. The results indicate that our method outperforms other methods in emotion recognition tasks. Specifically, our method has achieved significant improvements in accuracy, recall, and F1 scores. In addition, we conducted a series of ablation experiments to verify the impact of each component on overall performance.

3 INTERACTIVE OPTIMIZATION OF CAD SYSTEM

In the field of HCI, user behavior research is the key to optimize product design. For CAD systems, a deep understanding of user behavior can reveal the pain points of designers in the process of use, which is helpful to improve system functions and interactive design. Through user behavior modeling, we can study the user's behavior data such as operation sequence and task completion time in CAD system. These data can be used to analyze users' behavior patterns, and then provide decision support for the optimization of CAD system. Design psychology emphasizes the design from the psychological needs of users. In the CAD system, designers need to complete the design tasks efficiently and accurately, and expect to get a good emotional experience in the use process. Design psychology provides theoretical support for the optimization of CAD system, helps designers to better understand user needs and create a better user experience. In the CAD system, too high cognitive load may cause designers to feel tired and frustrated in the use process. By reducing the cognitive load, the usability and user satisfaction of CAD system can be improved. Design psychology provides methods to reduce cognitive load, such as simplifying interface design and optimizing task flow. In CAD system, positive emotional experience can improve the work efficiency and creativity of designers. Through emotional design, we can increase the attraction of CAD system and improve the loyalty of users to the system. With the progress of science and technology and the improvement of user demand, the interactivity of CAD system has gradually become the focus of research. This section will propose an HCI optimization strategy based on the emotional experience identification algorithm of product design images, and elaborate it in detail with the combination of user behavior and design psychology. First of all, it is necessary to collect screen shots and operation videos of designers in the process of using CAD system to build an emotional image database. Using computer vision and deep learning technology, features related to emotional experience are extracted from emotional image database. Based on the extracted features, an emotion classification model is trained. The model can map image data to specific emotional categories, such as pleasure, confusion, satisfaction and so on. The trained emotion classification model is integrated into CAD system to realize real-time emotion experience recognition. The frame design of emotional experience identification algorithm for product design images is shown in Figure 1.

In order to ensure the objectivity and accuracy of weight determination, expert experience is used to assign weights, and the final weights of each characteristic indicator are obtained by taking the average value. Firstly, clarify the characteristic indicators of the CAD system that need to be evaluated. These indicators may include rationality of interface layout, operational efficiency, humanization of task processes, degree of personalized customization, etc.

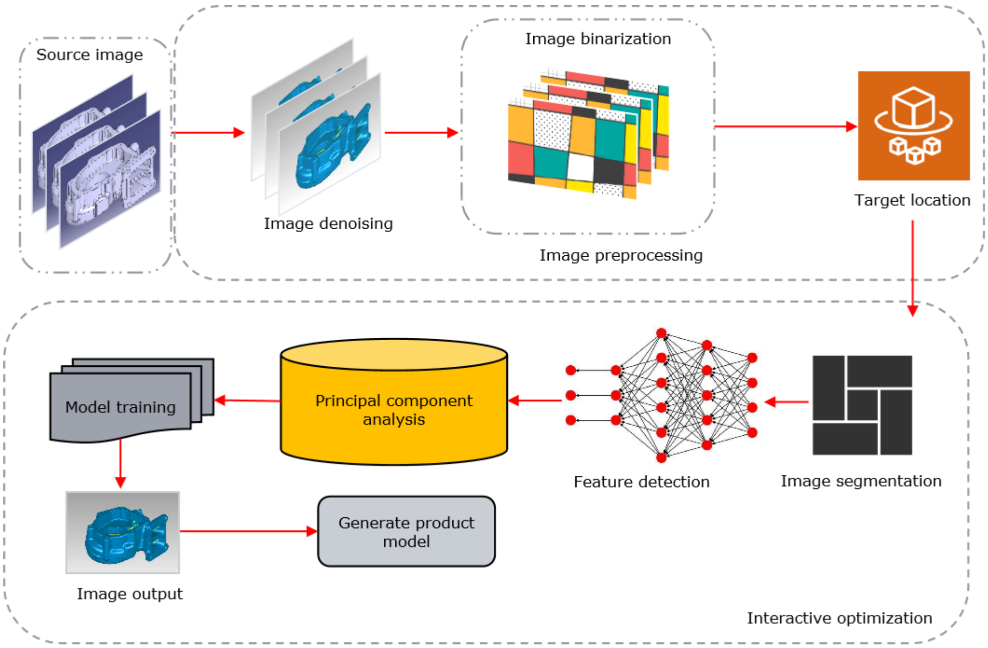

Figure 1: The framework of emotional experience identification algorithm for product design images.

Experts should have a deep understanding of CAD systems and interaction design background to ensure that they can accurately assign weights to various characteristic indicators based on experience. Each expert independently assigns weights to each characteristic indicator. This is usually a relative process, for example, experts can use ratios or numerical values to represent the importance of each characteristic indicator. In this process, experts will allocate corresponding weights based on their own experience and understanding, taking into account the impact of different characteristic indicators on interaction performance. For each characteristic indicator, calculate the average of the weights given by all experts.

The weight of each characteristic index is given by experts according to their experience, and then the average value of the weight given by experts is taken as the weight of each characteristic index:

$$\eta = \ \eta_1,\eta_2,\cdots,\eta_n \tag{1}$$

η_j reflects the position or role of the j index in all characteristic indexes, which directly affects the results of cluster analysis.

Calculate the comprehensive clustering coefficient σ_i^k of object i about grey class k as follows:

$$\sigma_i^k = \sum_{j=1}^{m} f^k\ y_{ij}\ * \eta_j \tag{2}$$

$f^k\ y_{ij}$ is the whitening weight function of k subclass, and η_j is the weight of j index.

Establish several data subsets of size n, and set the sample weight of each subset to 1. By calculating the gray clustering center y of the first group of samples with a weight of 1, the smallest sum of squares of clustering errors $D\ y$ is obtained:

$$D(y) = \min_{1 \le k \le n-1} \sum_{i=1}^{n} \omega_i \left(y_i - y_{i,k} \right)^2 \tag{3}$$

Where: ω_i is the weight of the i th index; y_i is the database mapping value of the i th indicator; $y_{i,k}$ is the mapping value of the i th index database of the k th cluster center.

Based on user behavior data, analyze the common functions and operation paths of designers in CAD systems, optimize interface layout, reduce operation steps, and improve operation efficiency. Based on the principles of design psychology, improve the task flow of CAD systems. By simplifying and optimizing task processes, designers can reduce their cognitive load and improve user experience. Provide personalized CAD system customization services based on the usage habits and emotional experiences of each designer. By adjusting the interface style, color matching, etc., designers can enhance their emotional experience during use. Introducing artificial intelligence technology to provide designers with intelligent auxiliary functions, such as automatic completion and intelligent recommendation. These functions will be adjusted and optimized in real-time based on user behavior and emotional experience data, improving the work efficiency and satisfaction of designers.

Based on the analysis of the overall framework of interactive design of CAD system, the bottom algorithm of system interaction is designed by using big data information processing technology. The time domain function of constructing the big data distribution of system interaction is:

$$\dot{x}_j^i = f_j^i \left(x_j^i, u_i, u_j \right) \tag{4}$$

In the formula, x_j^i represents the number of data points for system interaction transmission at the j th sampling node, and i represents the dimension of the underlying database for system interaction. in:

$$x_j^i \in R^n \tag{5}$$

In the m-dimensional phase space, the order of the system interaction design is given as n, when the system interaction hierarchical feature distribution satisfies:

$$u_i \in R^m \tag{6}$$

Cross-compilation is adopted for information clustering, and the output clustering attribute feature distribution of big data clustering is obtained as follows:

$$x = \left[\ldots, x_i, x_j^i, \ldots \right]^T \in R^{n \times N} \tag{7}$$

According to the inter-class dispersion of big data distribution, the fuzzy clustering center function of big data interaction is obtained as follows:

$$\dot{x} = f(x, u) \tag{8}$$

The cluster vector set of fuzzy hierarchical output is:

$$X = \{ x_1, x_2, x_3, \ldots, x_n \} \subset R^s \tag{9}$$

4 SVM BASED USER SENTIMENT CLASSIFICATION MODEL

SVM is a widely used machine learning model for classification and regression analysis. It is based on statistical learning theory and achieves classification by finding the best hyperplane. SVM performs well in solving small sample, nonlinear, and high-dimensional pattern recognition problems, making it suitable for user sentiment classification tasks. The basic principle of user sentiment classification is shown in Figure 2.

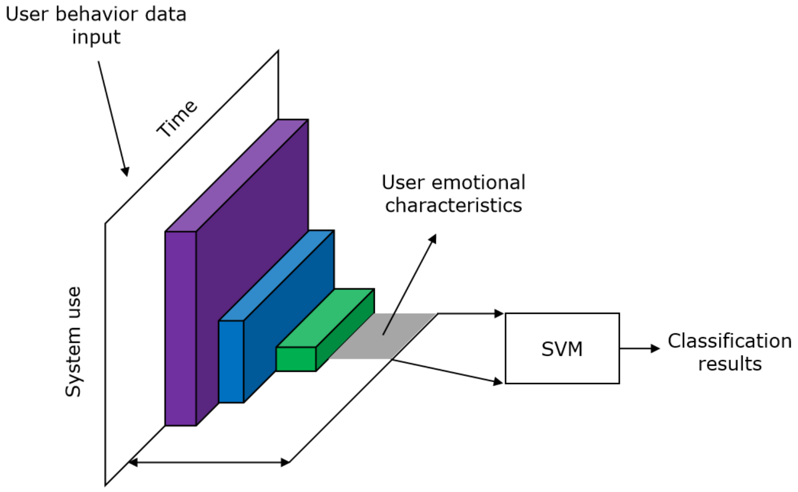

Figure 2: User sentiment classification.

In order to train the emotion classification model, it is necessary to collect the emotion data of users in the process of using CAD system. This can be obtained by questionnaire survey, facial expression analysis, pronunciation and intonation. Cleaning and preprocessing the collected original data, including data standardization, feature extraction, feature selection and other steps [19]. These processes are aimed at extracting the most relevant features of emotion classification and reducing noise and redundant information. The preprocessed data is transformed into a feature vector representation suitable for SVM model training. The trained SVM model is integrated into CAD system to realize real-time classification of user emotions. The results of real-time emotion classification are used as feedback to further optimize the interactive performance and user experience of CAD system.

The user's emotion varies widely. In order to avoid the data with a large range of values drowning the data with a small range of values, the data is normalized before being input to SVM:

$$x^{'} = \frac{x - x_{\min}}{x_{\max} - x_{\min}} \tag{10}$$

In this formula, $x^{'}$ represents the normalized value, and $x_{\max}, x_{\min}$ represents the maximum value and the minimum value respectively.

In the implementation of SVM user emotion classification algorithm based on regression prediction, risk function is introduced:

$$R_{reg} = \frac{1}{2}\|w\|^2 + C \cdot R_{emp}^{\varepsilon}[f] \tag{11}$$

$\|w\|^2$ represents a description function related to user emotion classification, C represents a constant, and f represents the complexity of user emotion classification function.

When emotional words and negative words are combined, their emotional tendencies will be completely opposite, and the negative words in different positions have different influences on emotional tendencies. Accordingly, this article makes appropriate improvements to the algorithm of systematic interaction emotional tendencies:

$$T = \sum_{x=1}^{y} a_x b_x \tag{12}$$

Where y represents the total number of emotion vectors, a_x represents the negative word weight matched by the x emotion vector, and b_x represents the emotion tendency of the x emotion vector.

Through the results of emotion classification, identify which operations or interfaces users have negative emotional reactions. Combining emotion classification results with user behavior data, a more comprehensive interactive experience analysis can be obtained. Based on the analysis of emotion classification results, this article puts forward targeted optimization strategies, such as improving interface design, simplifying operation process and adding intelligent tips. After the implementation of optimization, the user's emotion classification results are continuously collected, and the optimization effect is evaluated, and further iteration and optimization are carried out as needed.

5 SYSTEM TESTING AND ANALYSIS

5.1 Feasibility Test of Emotion Analysis Model

Figure 3 shows the precision test results of the two algorithms in user emotion recognition. As can be clearly seen from Figure 3, the precision of the studied algorithm in user emotion recognition is higher than that of the traditional method. This shows that the algorithm has higher accuracy in identifying users' emotions. The precision of traditional methods in emotion recognition is relatively low. This may be because traditional methods are based on simpler features or models and cannot fully capture the nuances and complexity of emotions. This algorithm effectively improves the accuracy of emotion recognition by introducing more complex models, deep learning techniques or other optimization strategies.

Figure 3: Comparison of recognition accuracy of deep learning algorithm.

Figure 4 shows the specific training loss of the algorithm, from which we can observe the convergence performance of the algorithm in the iterative process. The algorithm basically converges when it iterates about 85 times. This shows that the algorithm has a high convergence speed and can approach the optimal solution in less iterations. Fast convergence can save training time and improve training efficiency, which is very beneficial to emotion recognition tasks in practical applications.

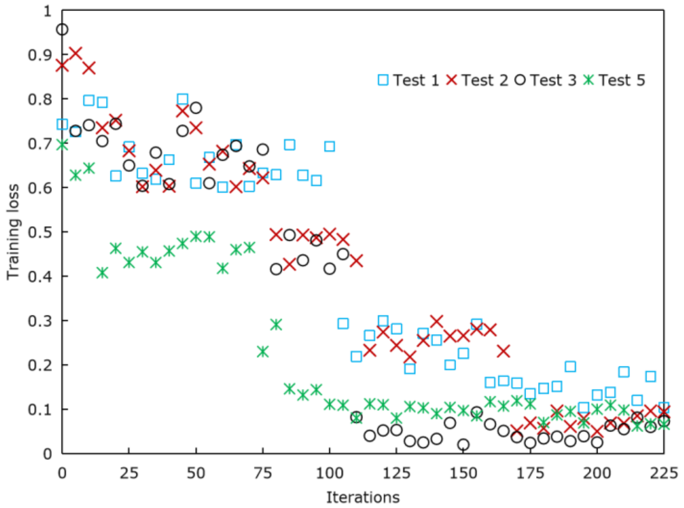

Figure 4: Training loss of algorithm.

In the iterative process, the value of the loss function shows a steady downward trend, and there is no obvious fluctuation. Too early convergence may lead to under-fitting, and too late convergence may lead to over-fitting. By converging within an appropriate number of iterations, the algorithm can avoid over-fitting, thus enhancing the generalization ability of the model and making it perform well on new and unknown data.

Figure 5 shows the emotional feature recognition time of different methods. By analyzing the data in Figure 5, we can clearly observe the difference in emotion recognition time between our algorithm and the traditional algorithm.

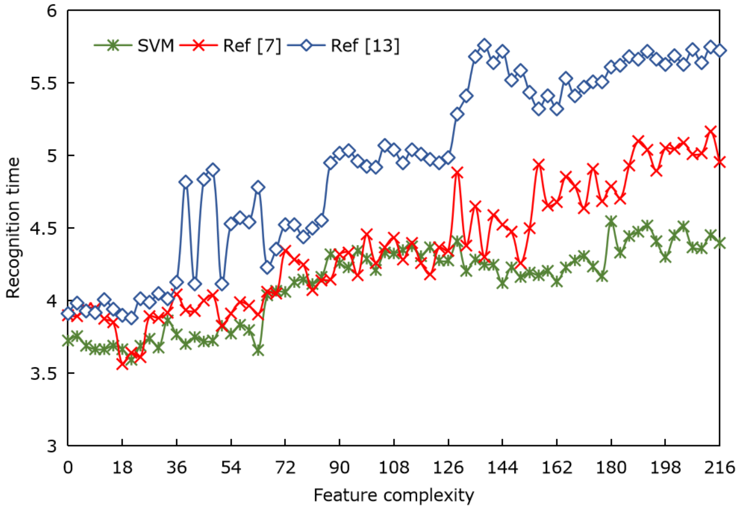

Figure 5: Time comparison of emotional feature recognition.

The emotion recognition time of this algorithm is obviously less than that of the traditional algorithm. This means that under the same computing resources, the algorithm in this article can complete the identification of emotional features faster. The improvement of time efficiency is of great value in practical applications, especially in situations that require real-time feedback or large-scale processing, and it is very important to identify emotions quickly. Efficient computing not only reduces the waiting time, but also makes the algorithm feasible in a wider range of application scenarios, such as mobile devices or resource-constrained environments. Traditional methods may require more computing time and resources to complete the task of emotion recognition. This is related to the algorithm complexity, feature extraction methods or other processing strategies.

To sum up, the algorithm in this article shows the feasibility of HCI experience assessment in CAD system. It can not only accurately identify users' emotions, but also has the advantages of fast convergence and efficient identification. These characteristics make the algorithm suitable for practical CAD systems and can provide reliable assessment results of HCI experience.

5.2 Assessment of HCI Experience in CAD System

Figure 6 shows the comparison of the effects before and after the optimization of the product design image with noise in the CAD system, and it can be seen that the image quality after optimization has been obviously improved.

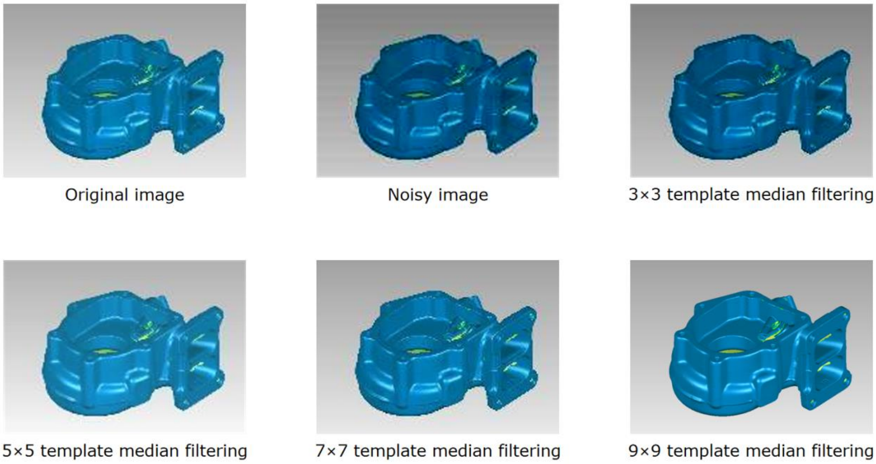

Figure 6: Image processing effect of CAD system.

Noise may cause the details to be blurred and illegible in the original image, but in the optimized image, these details become clearer and clearer. This improvement in quality helps designers to better understand and evaluate the details of product design. By applying this algorithm to optimize the CAD system, the product design image with improved quality can be obtained. This shows that the algorithm in this article has practical application value in guiding interactive optimization of CAD system. By optimizing the quality of product design images, this algorithm indirectly improves the work efficiency of designers. Designers can understand the details of product design more clearly and accurately, and reduce misunderstandings and corrections caused by image quality problems. This will enable designers to concentrate more on creativity and design, and improve the overall design efficiency. The image quality assessment result of CAD system is shown in Figure 7.

By analyzing the image quality assessment results of the CAD system in Figure 7, we can see that the algorithm in this article has achieved remarkable results in optimizing the image quality of the CAD system. These improvements are not only reflected in the structural information and visual effect of the image, but also in the texture details of the image, which improves the image quality of the CAD system in an all-round way and brings designers a more accurate design experience. The application of this algorithm has obviously improved the image quality of product design, and verified its effectiveness in interactive optimization of CAD system. The interactive experience scores of users before and after using the optimized system are shown in Table 1.

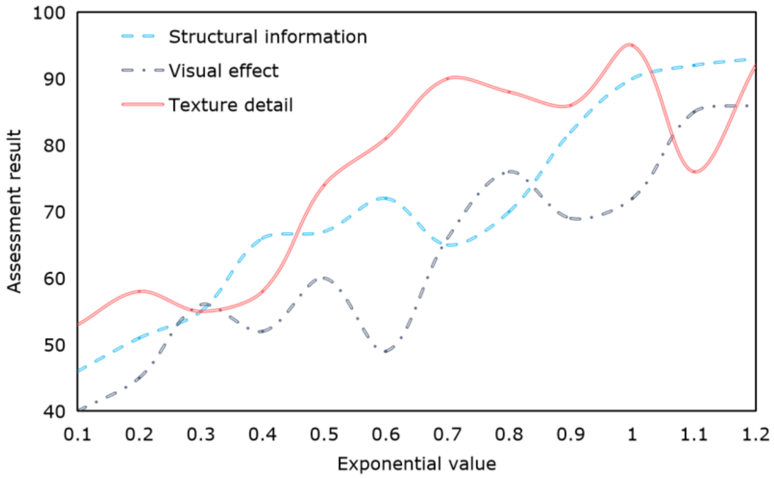

Figure 7: Image quality assessment results.

Index	*Original system experience*	*Optimized experience*
Interface comfort	78.5	89.1
Operation convenience	77.7	89.2
Image processing effect	68.3	92.4

Table 1: User usage rating.

According to the data in Table 1, the score of the optimized CAD system in terms of interface comfort is obviously higher than that before optimization. This shows that the optimized system is more in line with users' visual habits and operating habits in terms of interface design, color matching and layout, and provides users with a more comfortable operating environment.

Comfortable operation interface can reduce users' visual fatigue and operation pressure, and improve users' efficiency and satisfaction. The improved interface comfort of the optimized CAD system will bring more pleasant operation experience to users. The convenience of operation has an important influence on the work efficiency of users. The optimized CAD system can help users reduce operation steps and improve operation efficiency by improving operation convenience. Image processing effect is one of the important indexes to evaluate system performance. The optimized CAD system provides users with clearer and more realistic image effects by improving image processing algorithms and improving image quality. Figure 8 clearly shows the comprehensive score of HCI experience before and after CAD system optimization. Judging from the comprehensive assessment results, the performance of the optimized CAD system in three aspects: interface comfort, operation convenience and image processing effect is obviously better than that before optimization, and the average comprehensive experience score is over 90. Judging from the scoring results, the interface comfort, operation convenience and image processing effect of the optimized CAD system are better, and the average comprehensive experience score is over 90.

The advantage of this algorithm in emotion recognition provides a more accurate and intelligent user feedback mechanism for CAD system. The fast convergence and efficient calculation time of the algorithm mean that the CAD system can respond to the user's operation and design requirements more quickly, reduce the waiting time and improve the fluency of the whole workflow.

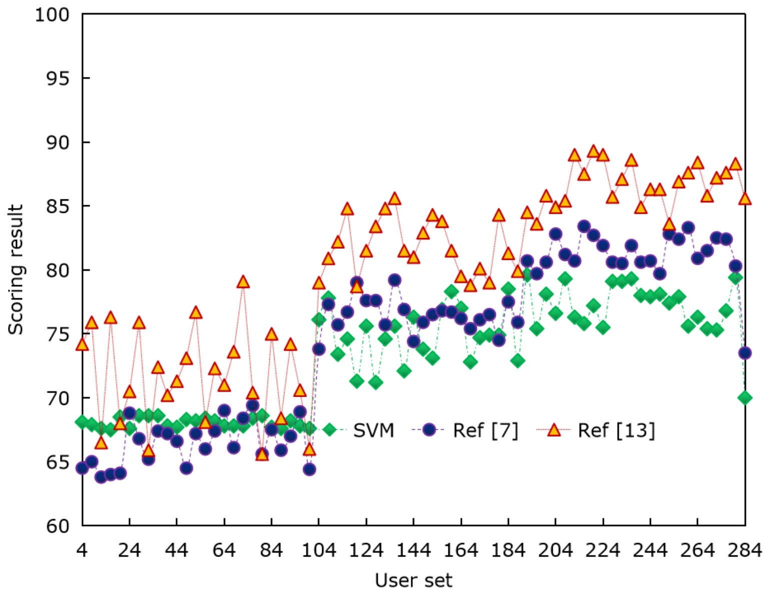

Figure 8: Subjective scoring results.

By optimizing the image quality of CAD system, this algorithm improves the accuracy and feasibility of design. Clear image structure and rich texture details provide designers with better design reference, which is helpful to reduce the number of design iterations and errors and improve design quality. The significant improvement of HCI experience score is the direct embodiment of the algorithm optimization work in this article. The improvement of interface comfort, operation convenience and image processing effect comprehensively improves the designer's experience, makes the CAD system more suitable for the designer's needs and operating habits, and thus improves the designer's work efficiency and user satisfaction.

6 CONCLUSION

CAD system plays a vital role in modern engineering design. By analyzing user behavior, we can reveal the actual operation of users in CAD system and find out potential problems and bottlenecks. Design psychology can help us understand the psychological process and emotional experience of users, so as to design an interactive interface and operation process that is more in line with the user's mental model. In this article, HCI optimization of CAD system is studied by combining user behavior and design psychology. In this study, the user emotion classification model based on SVM is introduced to analyze and evaluate the HCI experience of the optimized CAD system. By optimizing the image quality of CAD system, this algorithm improves the accuracy and feasibility of design. Clear image structure and rich texture details provide designers with better design reference, which is helpful to reduce the number of design iterations and errors and improve design quality. By continuously optimizing the HCI experience, it is helpful to reduce the design cost, reduce the number of design iterations, and further promote the innovation and application of design. At the same time, the research methods and achievements in this article can also provide valuable reference for HCI optimization of other computer-aided systems.

The future CAD system can further combine artificial intelligence and machine learning technology to achieve a higher degree of intelligence. By deeply learning the user's operating habits and preferences, the system can provide users with a more personalized HCI experience and further improve the design efficiency.

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