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# Construction and Implementation of Computer Aided Design System for Art Graphics

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**Abstract.** With the rapid development of computer technology, the application of computer has penetrated into various fields, and the application of computer technology in art design has gradually increased. In order to improve the efficiency and overall level of art design, a computer-aided design system of art graphics was designed and developed based on a comprehensive analysis of the needs of art design. This article introduces the construction and implementation of computer-aided design system for art graphics, including system architecture, functional structure, database design, and system function implementation. The function and performance analysis of the system shows that the computer-aided design system based on art graphics can shorten the development cycle of art design works, improve the efficiency of art design work, and facilitate the simulation and inspection of art works. Based on the requirements of art graphic design, the development of computer art graphic aided design system will not only help to improve the efficiency of art design, but also further improve the level of art design. We will conduct in-depth exploration of the development of China and provide theoretical and technical support.

**Keywords:** Art Graphics; Computer-aided Design; System Construction
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## 1 INTRODUCTION

Computers are widely used in the field of technology, but with the development and progress of computer technology, they have gradually been applied in the field of art, which has become a key factor in promoting the reform and innovation of industrial production and visual design [1]. In the development of art design, in order to be able to conform to the trend of the development of the information age, the application of computer-aided design has become widespread. Computer art is also called computer art. Computer-aided design can play a key role in multimedia technology design, such as 3D animation design and webpage design. The emergence of rendering modeling tools such as Lumion has raised the design work to the level of three-dimensional space [2]. From plane to three-dimensional, landscape designers have made a new leap forward. They can understand and observe their garden landscape design works from different perspectives. The final

scene has a higher and more comprehensive grasp. Computer technology such as virtual reality has turned static into dynamic, and through some sensing devices, simple visual feelings have been extended to other senses.

The early development of computer-aided systems mainly depends on major electronic and electrical companies in the world, such as SIMENS in Germany, GE in the United States, and PHILIPS in the Netherlands. These companies have introduced computer-aided systems that are attached to their scanning equipment. However, these systems not only require highly-configured hardware, but they are also sold at very high prices. In order to get rid of this situation, many emerging companies began to study hardware-independent computer-aided systems, such as the Mimics system developed by Martínez-Noya and others from Belgium's Maerialise Company [3], the 3DMed system developed by Dias-Neto and others from Able Software Company in the United States [4], and the Amira system developed by De Meyer and others from Visage Company in Europe [5]. They all get rid of the dependence of computer-aided systems on hardware, and can complete various real-time operations through integrated functions. MTK package with 2D image processing and 3D reconstruction developed by Liu and others [6] from the Chinese Academy of Sciences. 3D medical visualization MedVis system with good interactivity and real-time development developed by Krekhov and others [7] from Zhejiang University CAD & CG laboratory. Dai [8] developed with 2D image analysis and 3D reconstruction Three-dimensional medical image system.

This study fully considers the usability and innovation of computer art design assistance system, and based on the analysis of the art design concept and computer aided design technical details, the needs and feasibility analysis of the assistance system are carried out. According to the specific needs analysis and feasibility analysis results, the framework design of the auxiliary system is included, which mainly includes the specific functional division of the system and the design of each module. Finally, the function and performance analysis of the system is carried out in order to design a composite current social demand Computer aided art graphic design system.

## 2 CONSTRUCTION AND IMPLEMENTATION OF COMPUTER GRAPHICS AIDED DESIGN SYSTEM

### 2.1 Demand Analysis

The traditional drawing method is mainly used in the conception stage of a design. Designers draw design inspiration by drawing on paper with a pen. This method has relatively low requirements on the accuracy of the drawing, but it takes a long time to draw, and it is not easy to modify. If there is a problem or needs to be modified, the designer needs to redraw the entire solution. Drawings drawn by traditional methods have high artistic aesthetics, and they are also in line with people's writing and drawing habits. However, designers need to have certain painting skills. The design concept is a preliminary idea that reflects the designer's design plan. The drawing on the pen and paper gradually defines the design materials and design plan. It is also the process in which the designer gets inspiration during the design process and continuously optimizes the design plan.

Computer art design assistance system is used by art designers and managers. As far as art designers are concerned, the main requirement of system design is to improve the effect of art design and system processing efficiency. Through the system application, it can provide art designers with the functions of constructing art models, providing design material selection functions, providing lighting layout functions, providing software script viewing and downloading functions, providing design preview and work modification functions. For system administrators, the system can provide administrators with functions such as script management, data statistical analysis, user management, and system configuration management. Designers and managers related needs analysis shown in Figure 1.

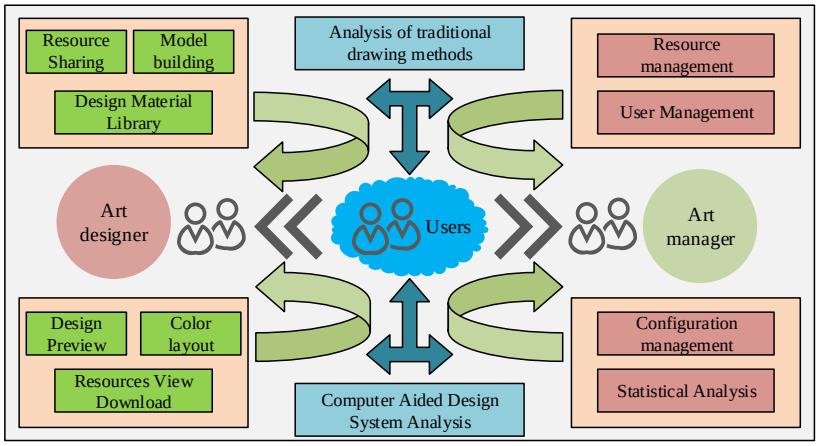


**Figure 1:** Demand analysis for art designers and managers.

## 2.2 System Architecture Design

The system uses a classic three-tier architecture model, and the architecture design is shown in Figure 2. The design of the system's script sharing platform is based on J2EE technology. The technologies used include JavaScript technology, HTML technology, and Servlet technology [10]. In system design, the corresponding technology is selected according to the system function and design needs. The computer art design auxiliary system is divided into three levels: data maintenance layer, business logic processing layer, and display layer. Each layer has its own independent function and plays a corresponding role. During system operation, even if a certain level changes, as long as the interface type remains unchanged, the entire system can still operate normally, which is conducive to ensuring stable system performance and safety and reliability.

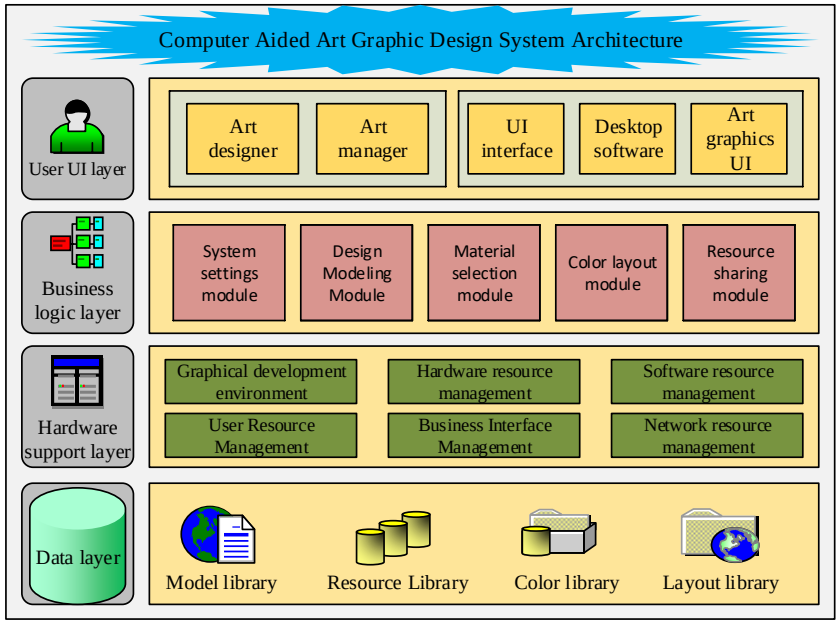


**Figure 2:** System architecture diagram.

The system network architecture mainly includes the Internet, internal and external networks, service networks, local area networks, firewalls, and others. And there is a one-to-one correspondence between network architecture diagrams and auxiliary systems. Designers or users can access the system through the Internet or local area networks. All functions of the system can be accessed through the local area network, while users can only use some functions when entering the system through the Internet. Figure 3 shows the system network architecture diagram.

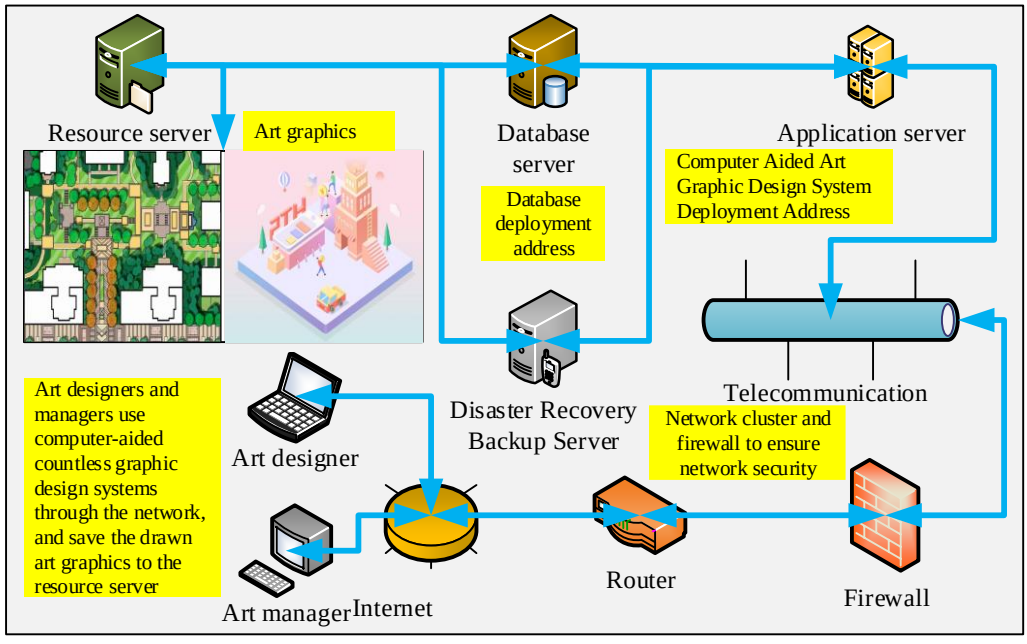


**Figure 3:** Network architecture diagram.

### 2.3 System Database Design

This design system uses SQL 2008 database to realize the storage of data. The functions provided by the system for the designer include data entry, modification, and deletion. During the operation of the system, the system automatically retrieves data from the database for the administrator to browse. Some data tables in the database are as follows.

| Field Name | length | Field Type | Allow empty | Primary key | Function description |
|---|---|---|---|---|---|
| User_id | 40 | varchar | no | yes | user ID |
| User_name | 40 | varchar | no | no | user name |
| User_pwd | 40 | varchar | no | yes | user password |
| User_power | 8 | int | no | no | User rights |

**Table 1**: User information table.

Database storage information types mainly include user information and script information. The user information database mainly stores users' personal information, identity rights, and usage

records (Table 1), while the script information database mainly stores works that have been uploaded, and stores relevant descriptive information (Table 2).

| Field name | Types of | length | Can it be empty | Note |
|---|---|---|---|---|
| share_id | int | 20 | no | mainKey |
| share_name | varchar | 300 | no | no |
| share_mess | varchar | 600 | yes | no |
| Share_type | int | / | no | no |
| share_ime | data | 8 | no | no |
| share_user | varchar | 40 | yes | no |
| share_ size | double | / | no | no |
| share_path | varchar | 600 | no | no |
| share_other | varchar | 400 | yes | no |

**Table 2**: Shared resource table.

### 2.4 System Function Implementation

After the design task is completed, the system is debugged to ensure the normal operation and function of the system. The system has a custom menu function, and can interact with users through the menu to meet the needs of designers and managers. At the same time, the system can also realize the management of materials. In the course of teaching, the teacher can add the course content in the form of pictures, text, video, audio, which is convenient for the management of teaching content and learning materials. Student learning needs. In addition, the system also provides a query function. Students can query the design and performance of the work through the system, and at the same time can receive user feedback on the work.

The functions of the system mainly include a system setting management function module, a design modeling management function module, a material selection management function module, a color layout management function module, and a design result sharing management function module. Figure 4 is the overall functional design of the system.

(1) System setting management. This function module mainly includes functions such as creating new design works, opening design works, previewing design works, saving design works, adding materials, and managing system configuration. The above functions are the main content of art design auxiliary functions, and applications of other modules can also call the function of this module.

(2) Design modeling management. Regarding the design of art works such as size, material, radian, etc., adjust the edges of the works to meet the requirements of the works, adjust the size and materials to make the works more beautiful, and finally improve the design level of works.

(3) Material selection management. Provide a variety of materials for the design of fine art works. At the same time, you can add, subtract, replace or modify the fine art materials, so that the materials more meet the needs of the work design. There are two main ways of providing: the first is the default standard materials of the system, such as marble, metal, wood, and metal; the second is the material maps that the designer manually draws according to user needs.

(4) Color layout management. The main functions include the selection of the environmental background and the setting of the color of the light source, etc., to select and design the background and color of the artwork.

(5) Design results sharing management. This function module uses J2EE technology and database application technology, and based on this, it implements Mel software script management and sharing functions. Based on database technology, it implements script sharing and management. It can also implement works query and download functions, and promote works. Sharing, effectively improving the design effect of art works.

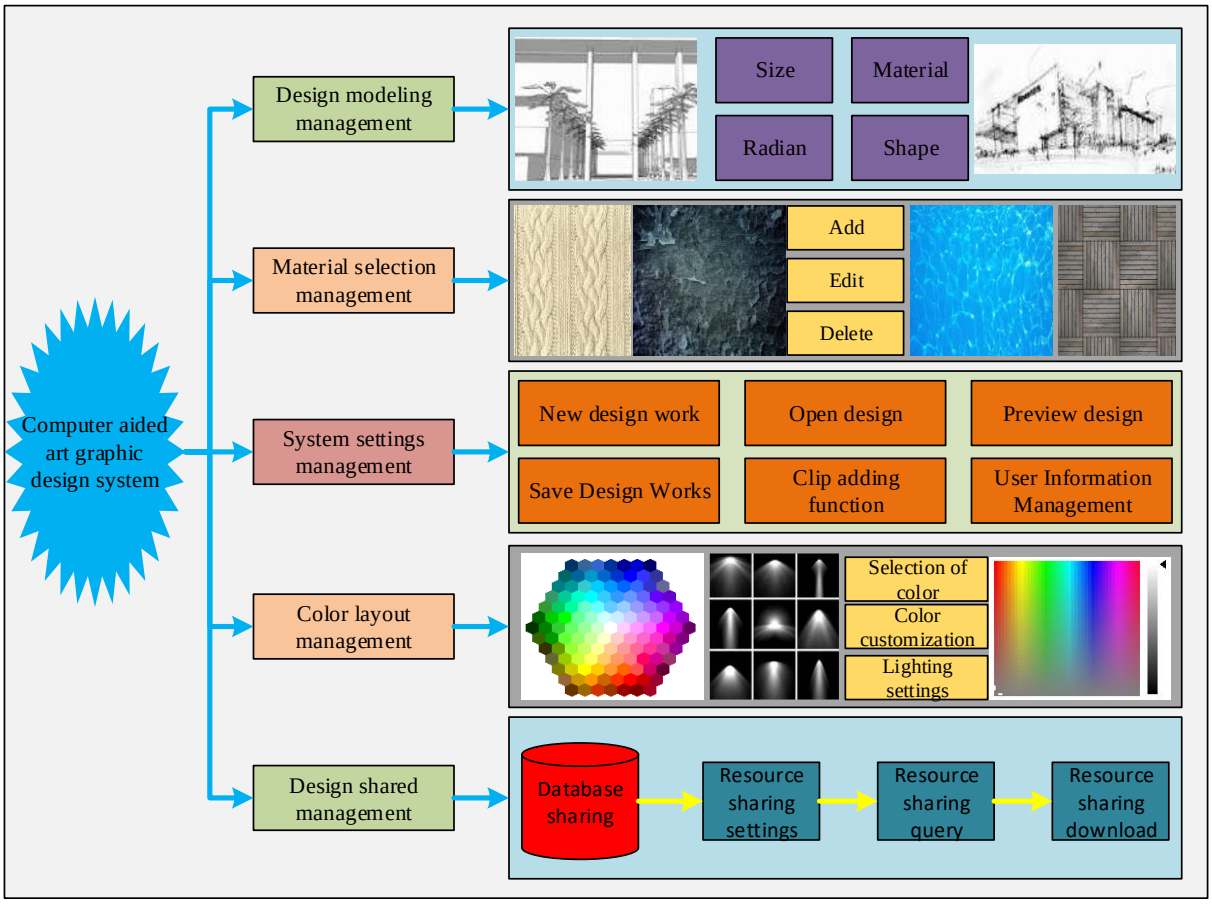


**Figure 4:** System functional design.

Scanned versions of all the data art graphic albums in this article, from the Han Dynasty to the Qing Dynasty, span the east, central and west regions, covering the subject matter of art graphics in different dynasties and regions. By researching the collected art graphics art images, the category of the data set is set to 8 types of art images. Due to the difficulty in obtaining mural images and limited training data, it cannot meet the condition that a convolutional neural network model requires a large amount of training data. In order to avoid over fitting the model, the collected data is extended using data set enhancement algorithms such as scaling, brightness transformation, noise addition and flipping. Adding noise is to randomly add Gaussian noise with Sigma of 25 and pepper and salt noise with randomly selected points set to 0 or 255; the brightness change is 0.5 times and 1.5 times of the original lightness and darkness of the image. Among them, the murals in the training set are 7,555, and the murals in the test set are 4,076. Due to the large number of images, the secular people have a larger amount of data than other categories.

Network width and depth are the two key factors that affect the model's performance. This article improves the Alex Net model based on these two points. First, from the perspective of depth, in order to prevent the mural image itself from being of a smaller order of magnitude, in order to prevent the overfitting phenomenon, it is proposed to delete the 4th and 5th convolutional layers of the original model, reducing the original model. Number of layers, and set the fully connected layer to 3. Secondly, for the single-layer network may not be enough to learn the

features of the image, combined with the influencing factors of the width, this paper widens the network to two channels to fully extract the mural features. Among them, these two channels have a three-layer convolutional layer structure and share the first layer of convolutional layers. Next, the dual channel features are merged to the same level, and the abstract features extracted by the three fully connected layers are used for classification. In the end, this paper proposes a 6-layer mural image classification network based on the feature fusion Alex Net model. This network (hereinafter referred to as AlexNet-D6) consists of a 3-layer dual-channel feature fusion layer and a 3-layer fully-connected layer. First, the input layer takes the original image as input 224 × 224 × 3, where 224 × 224 is the size of the image and 3 is the number of image channels. Secondly, the middle-stacked layer is set to two channels Channel1 and Channel2 with the same number of layers and the number of convolution kernels, and the abstract features of the image are extracted and passed to the classification.

## 3 APPLICATION ANALYSIS OF COMPUTER AIDED DESIGN SYSTEM

### 3.1 System Function Analysis

According to software requirements, use valid and invalid data input to run each function to verify that the software functions meet the following:

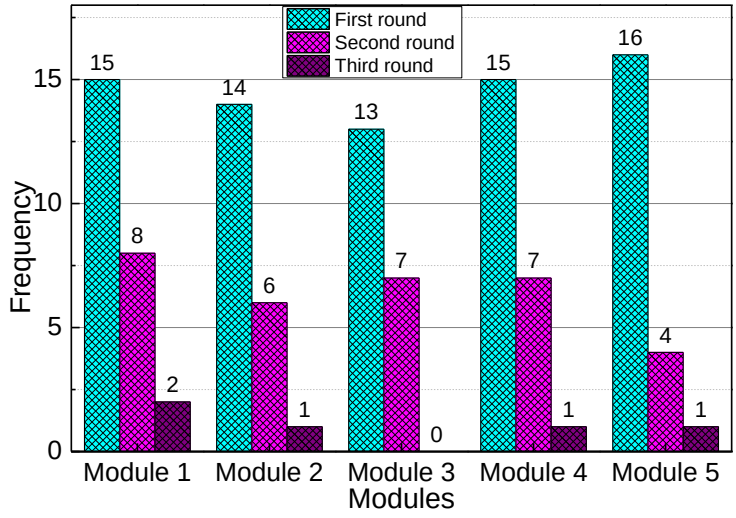


**Figure 5:** System functional test results.

(1) The expected results are obtained when valid data input is used, including whether the user interface is displayed correctly and the result data is correct.

(2) A corresponding error message or warning message is displayed when invalid data entry is used. According to the system requirements, functional tests were performed on the software functions one by one. The system in this paper passed all the test data.

Figure 5 shows the functional test results of all the functional modules. There are 3 rounds of regression tests. The remaining problems in each round are gradually reduced. After the three rounds of testing, the system functions are basically complete.

After the functional test, the system was tested for compatibility, and 32-bit Win7, 32-bit Win10, 32-bit Linux, 32-bit IOS, 64-bit Win7, 64-bit Win10, 64-bit Linux, and 64-bit IOS operating systems were installed, and .Net was installed. Framework 3.5 or 4.0 framework, the client is running normally.

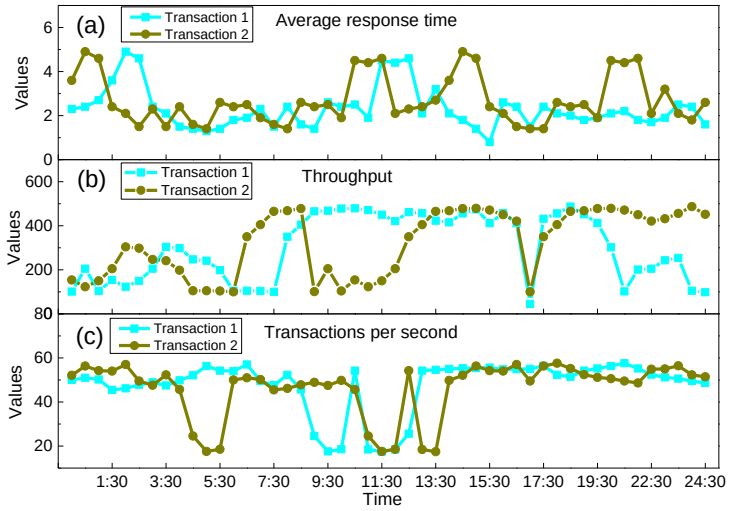


**Figure 6:** Transaction 1 and Transaction 2 average response time, throughput, transactions per second.

### 3.2 System Performance Analysis

The Load Runner 11 tool was used for performance testing. The test server hardware was 6-core 8G memory, and the software environment was: operating system Linux; database management system SQL 2008; network bandwidth 100M, hard disk capacity 2T. Use Load Runner to access the web page to form a script. In the script, set the start and return of access to the server-side interface to set up transactions: Transaction 1 is to open the design system login page; Transaction 2 is to download the script information. Create 500 virtual users and load them gradually. The average response time, throughput, and transactions per second of transaction 1 and transaction 2 are shown in Figure 6. The average response time of the system transaction in this paper is about 2.5 seconds, and the peak response time does not exceed 5 seconds, which meets the design goals. Operating system memory, CPU, network traffic, and hard disk usage are shown in Figure 7. The percentage of time that all processors in the system are busy is 50%, and half of the processors are busy; memory accounts for 65%, and the remaining resources are sufficient; Network traffic communication is normal; the remaining hard disk capacity is 1.2T, which can meet script sharing.

### 3.3 System Application Analysis

Through the computer-assisted art-assisted system, the product's creative solution can be three-dimensionally designed through three-dimensional modeling, and can be freely adjusted in terms of form, color, and texture. In the analysis and evaluation of the work, there is no loss in copying or downloading the work. People who have completed the work can share it, and the design tasks can be completed in stages, which effectively improves the work efficiency. Through the system's art graphics processing function, designers can simulate the shape of the designed product on the computer screen and optimize the product at the beginning of the design to achieve the purpose of reducing consumption and improving quality. Before the new product is put into use, it can also analyze and inspect the product's structure, assembly and other characteristics to improve the one-time success of product design. With the support of computer art design assistance system, complex procedures can be completed through program operation, and the shackles of hand-drawn mode can be eliminated. This will not only ensure the safety and reliability of the work, but also shorten the development cycle of the art work and improve the design effect of the work. Figure 8 is the time comparison between the traditional method and the use of a computer-aided

design system to process different art graphics. With the increase in the number of processing art graphics, the traditional method consumes more and more time.

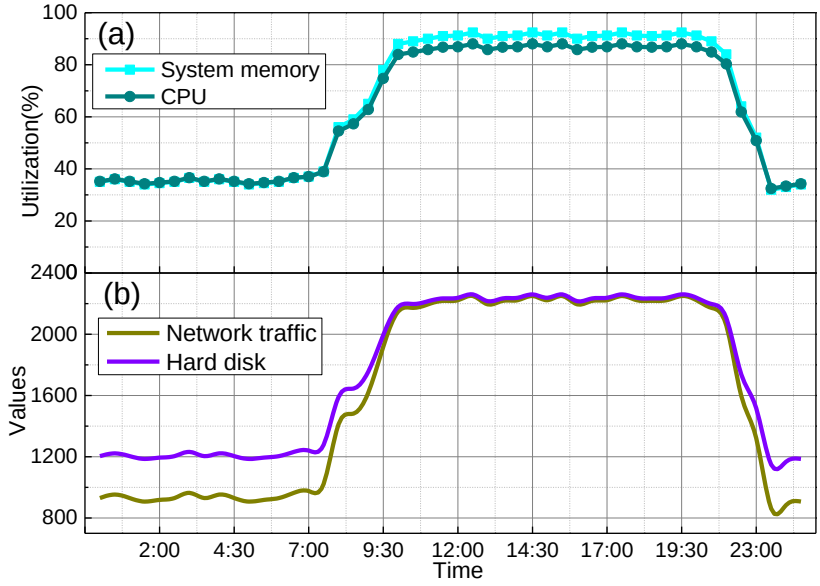


**Figure 7:** Operating system memory, CPU, network traffic, and hard disk.

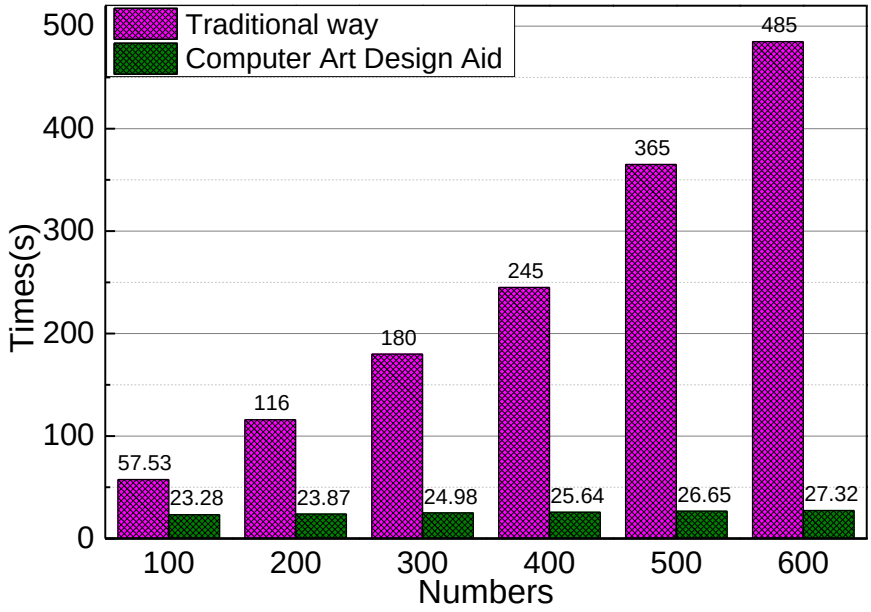


**Figure 8:** Time comparison analysis.

## 4 CONCLUSIONS

Aiming at the problem of traditional art drawing, this paper designs and implements a computer-aided design system for art graphics. In the system design, the classic three-tier architecture is

used to explain the system design issues of the business logic layer and data access layer, the design of the database, and the main functional modules, and a system design model is established. Through the analysis of three aspects of function, reliability and performance, the system designed in this paper has improved the science and efficiency of art graphic design, achieved good results, and reflected good practicability. The rapid development of computer-aided systems not only means a change in design technology, but also can make great breakthroughs in design thinking, further promoting the comprehensive and profound reform of manufacturing from product design to technology management. The application of computer-assisted systems can closely combine the accuracy and speed of computers with the creative thinking and design capabilities of designers, enabling products to be intelligent zed from conceptual design, modeling design, structural design, engineering manufacturing and other programs, thereby creating More economical, practical and beautiful products.

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