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Computer-Aided Design AND APPLICATIONS

# Application of Auto CAD Software in Multimedia Graphics and Image Processing

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**Abstract.** In order to solve the problems of poor image transmission effect and low efficiency of image information transmission in traditional multimedia image transmission automation digital system, this paper proposes a hardware and software design scheme of image transmission automation digital system based on CAD software technology. In terms of hardware, the image acquisition and processing module, image transmission module, image storage module, and image control module are designed. The experimental results show that the accuracy rate of image transmission is 98% in the CAD aided system scheme, and compared with the traditional transmission system, the efficiency of image information transmission in the image transmission automation digital system based on CAD aided technology is much higher than that in the traditional image transmission automation digital system, the efficiency of image information transmission is increased by 15.4%, and the accuracy rate of image information transmission is increased by 12.1%. Conclusion: The system designed in this paper is superior to the traditional system, with better image transmission effect, better accuracy, better effectiveness and reliability, and higher application value.

**Keywords:** Multimedia image; Auto CAD; Image processing; Application; Digital system.
**DOI:** https://doi.org/10.14733/cadaps.2024.S6.117-126

## 1 INTRODUCTION

Computer Aided Design (CAD) technology, as an important part of electronic information technology, is a key high-tech to promote the development and transformation of scientific

research achievements, promote the renewal and transformation of traditional industries and disciplines, realize design automation, enhance the competitiveness of enterprises and their products in the market, and accelerate the development of national economy and national defense modernization, it is also an important technical basis for further development towards computer integrated manufacturing (CIMS) [1].

In a broad sense, CAD technology includes two-dimensional engineering drawing, three-dimensional geometric design, finite element analysis, numerical control processing, simulation, product data management, network database and the integration technology of the above technologies (CAD/CAE/CAM) [2]. CAD application engineering is a high-tech intensive large-scale system engineering related to the research, development, promotion and application of CAD technology [3]. The implementation of CAD application engineering marks that China has made great progress on the road of "enterprise informatization and information enterprise". The use of CAD technology has made fundamental changes in the work contents and methods of product and engineering design and manufacturing. This technology has become an important means for manufacturing industries in developed countries to maintain competitive advantages and open up markets [4].

With the improvement of computer performance in order of magnitude, the price of computer has decreased exponentially; With the popularization of network communication, the intelligence of information processing and the practicality of multimedia technology; The popularization and application of CAD technology is more and more extensive and deeper. CAD technology is developing in the direction of openness, integration, intelligence and standardization. Since the 1990s, technical personnel engaged in scientific research and application development of CAD have realized that the key to making CAD technology become productive is to make designers use and be able to use CAD systems. Today, many localities and enterprises have promoted CAD and achieved good results, but there are still some problems worth discussing.

At present, in China, with the joint efforts of Zhejiang University, Wuhan External Equipment Institute of the Ministry of Mechanical and Electrical Affairs, Beijing Automation Institute of the Ministry of Mechanical and Electrical Affairs, Tsinghua University, Huazhong University of Technology, the Ministry of Aerospace Industry, the Institute of Automation of the Chinese Academy of Sciences and the Information Research Center of the Ministry of Mechanical and Electrical Affairs, a number of CAD support systems (CIEM, CADISENP1.1CAD, ZD-MCAD, etc.) have been developed and successfully used in minicomputers, workstations and computer environments. They have successfully solved the interface between graphics system and engineering database, finite element analysis and pre-post processing, physical property calculation, optimization design and other subsystems, and have initially formed the ability to develop CAD support software. In order to meet the needs of product design, they have carried out data collection, test and database building work in material properties, mechanical strength, labor, corrosion of metal materials, friction and wear, metal cutting and other aspects, it provides a reliable basis for CAD design.

For example, the Tianjin Automation Research Institute of the Ministry of Mechanical and Electronic Industry has successfully developed the "wheel loader CAD system" on the VAX minicomputer. The system uses the Bravo3 geometric modeling editor, graphics management system, VAX/RDB relational database software, ODS-2 optimization package and other system software as support software and has developed the wheel loader overall scheme design expert system, hydraulic transmission system parameter matching and optimization design, and hydraulic system CAD. With this system, the design of wheel loaders can be completed in a short time, which greatly improves the product development speed and overall performance.

However, in the field of imaging, especially in the field of medicine, scientific researchers also have some research on computer-aided diagnosis of esophageal cancer, emphysema and brain diseases. Yang, J. et al. mainly elaborated the key technologies and related theories of digital image processing through in-depth exploration of various aspects of digital image processing, providing a strong foundation for future development [5]. In the field of image, the problems of

poor image transmission effect and low efficiency of image information transmission in the automatic digital system of image transmission urgently need to be solved. Therefore, the hardware and software design scheme of an automatic digital system of image transmission based on CAD software technology has been proposed, which can effectively solve these problems.

## 2 RESEARCH METHODS

### 2.1 Introduction to CAD Technology

Computer aided design (CAD) and computer aided drawing (CAG) are inseparable. Computer graphics began in the United States in the 1950s and evolved from CNC machine tools. In 1952, the Massachusetts Institute of Technology successfully developed the first CNC milling machine processed in APT language. H. Joseph Gerber, an Austrian who studied in the United States at that time, founded Gerber Scientific Instruments in the United States. He produced the world's first platform plotter for Boeing based on the principle of CNC machine tools. In 1959, Calcomp Za of the United States developed the world's first drum plotter based on the principle of printer. The emergence of these two automatic plotters marks the beginning of the era of computer-aided drawing. Early computer graphics were mainly passive or static. According to the drawing software provided by the computer, people use high-level language to program, then compile and connect, and output the target program from the plotter to output the graphics. In the process of drawing, people can't do it in advance [6-7].

CAD is the most active field of computer application at present. The general design business mainly includes research and development assumption, basic product design, cost estimation, design drawing and auxiliary work for design (such as product research, continuing education for design, participation in relevant academic conferences, etc.). First of all, starting from the drawing that accounts for 40% of the design time, computer-aided drawing is not only a way to reduce the labor of designers, but also leads to a "design revolution". CAD has brought about the following changes in the design work:

- Making the design work deeper than ever.
- Improve the speed and quality of drawing design.
- Simplify the design process. After the computer is connected with the product standard database, all parts that have been included in the standard can be designed automatically by the computer. The designer only needs to tell the computer the standard parameters used.
- Design simulation and design inspection, using the 3D graphics function of CAD, can simulate the shape state of the designed product on the computer screen, optimize the product at the beginning of design, and analyze and inspect the structure, processing, assembly, decoration and dynamic characteristics in the manufacturing process of the new product before trial production, thus improving the first success of product design.
- The close combination of design and manufacturing. As mentioned above, the design data of CAD can be used for both design simulation CAE and numerical control processing equipment through data transmission system [8]. The design data can be directly used for product processing, namely CAM. CAD can automatically complete the conversion from design to processing program.

### 2.2 Hardware Design of CAD Image Transmission Automation System

It consists of image acquisition and processing module, image transmission module, image storage module and image control module. The hardware structure is shown in Figure 1.

#### *2.2.1 Image acquisition and processing module*

The image acquisition and processing module of the system includes cameras, microprocessors and sensors. The camera has high pixels and can capture images very clearly.

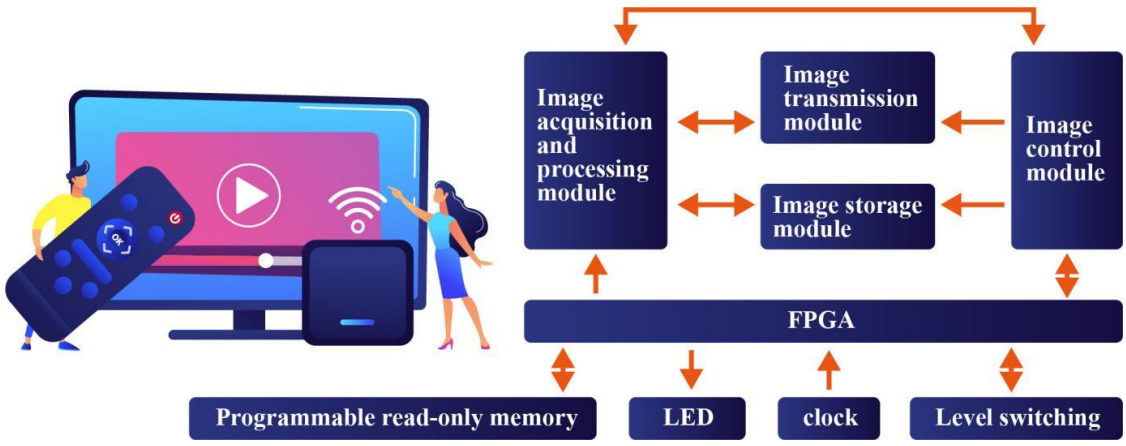


**Figure 1**: Hardware structure of image transmission automation digital system based on CAD technology.

The amplifier and A/D conversion circuit configured inside can realize digital output [9]. The schematic diagram of image acquisition and processing module is shown in Figure 2.

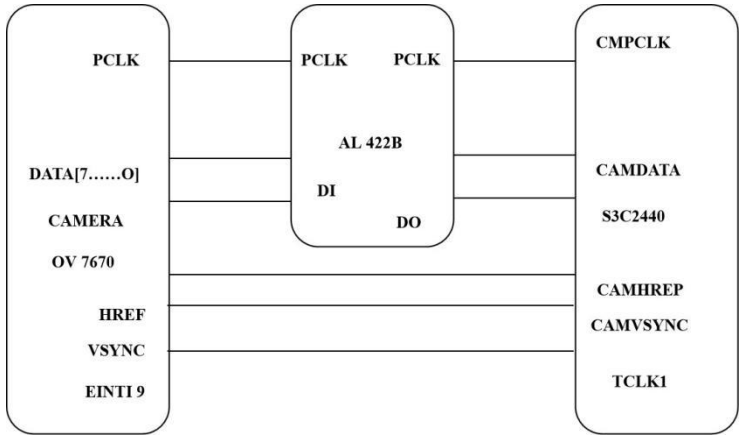


**Figure 2**: Schematic diagram of image acquisition and processing module.

It can be seen from Figure 2 that the sensor adopts OV7670. The sensor can support continuous scanning mode. The image format is QVGA, and the maximum pixel is 800×600. It fully meets the requirements of the system for image acquisition in this paper. The programming mode of the sensor is CCB, which can perform interlaced scanning. The collected image pixels are about 400000. The image acquisition is completed through the camera and sensor in the image acquisition module [10-12]. The microprocessor is the core part of the image acquisition and processing module. The microprocessor uses S3C2440A [13].

This microprocessor has low power consumption, belongs to industrial grade, and has good integration capability. The working frequency is 450MHz. When processing images, it can reach up to 550MHz. The speed of image processing is fast. It has a 32K instruction cache. Outside the microprocessor, there are 26 external interrupt sources and 12 general I/O ports. Through the introduction of MMU, it can achieve efficient image processing [13-14]. The image acquisition and

processing operation is completed through the image acquisition and processing module, as shown in Figure 3.

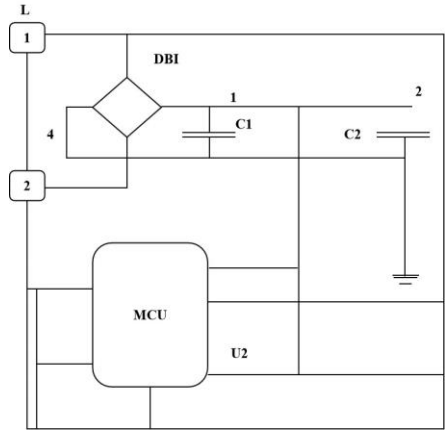


**Figure 3**: Circuit diagram of image collector.

### *2.2.2 Image transmission module*

In the image transmission module of this system, the infrared sensor is selected as the image transmission device. The advantage of this infrared sensor is that it can maintain the dynamic and multidimensional image, automatically radiate infrared, and improve the transmission effect of image information by rapidly radiating infrared. The automatic digital system of image transmission based on CAD technology aims to improve the effect and efficiency of image transmission. Using infrared sensor as transmission equipment can reduce the transmission time of the system [15]. The schematic diagram of image transmission module is shown in Figure 4.

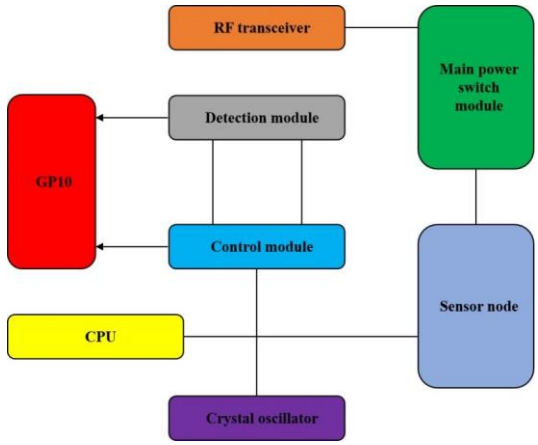


**Figure 4**: Schematic diagram of image transmission module.

When infrared sensor is used to transmit image information, the image acquisition and processing module first collects and processes the image. After receiving the command from the system, the sensor opens the probe and releases infrared radiation to the collected and processed image information. When the infrared radiation range reaches the rated range, the infrared sensor triggers the camera to make the camera capture and image, thus completing the transmission of image information.

### *2.2.3 Image storage module*

The image storage module of this system takes FIFO memory as the main storage device. This memory is a first-in, first-out, dual-port buffer. The FIFO memory has strong chip integration ability, complex functions, rich data resources, small size and convenient storage. Its memory space is 6Mbit, which can support FPGA. There is a pointer control circuit inside the FIFO memory, which can provide bus read memory for I/O ports and USB interfaces. The working frequency of the read port can reach up to 100MHz [16-17].

In the pointer control circuit, two pointer signals can be transmitted and connected to the USB interface along with the two serial image data. The image data is integrated in the FIFO memory and cached on the FPGA. The read/write operation of the image data is controlled through the FPGA coding, the image data stored on the FPGA is read out, the pointer signal transmitted is converted through the I/O conversion interface, and the image data is stored in the FIFO memory. The image data is stored through the image storage module, as shown in Figure 5.

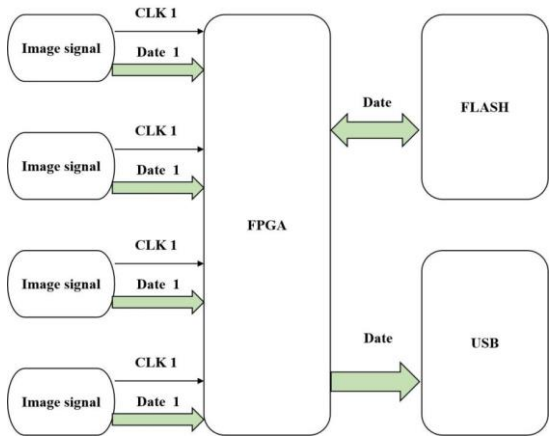


**Figure 5**: Image storage module.

## 2.3 Software Design of CAD Image Transmission Automation System

CAD is the English abbreviation of computer aided design. It can use computers and graphics equipment to design images, and assist engineering technicians to design products or engineering drawings through computer strong graphics and text processing ability. In the automatic digital system of image transmission based on CAD technology designed in this paper, the use of CAD technology can improve the degree of automation of image transmission, shorten the transmission cycle and improve the transmission efficiency [18-19].

### *2.3.1 Step 1: Manage the image data information base*

The image data information base includes image data acquisition, image data information transmission, and image data information reception. Image data acquisition can be realized through the image acquisition and processing module in the hardware. During image data acquisition, it is necessary to classify the types of image data to improve the efficiency of acquisition and shorten the acquisition cycle [20].

### *2.3.2 Step 2: Display three-dimensional images*

After the management of the image data information base, the processed image information is used for plane and 3D design using CAD aided technology. During the plane design, the images in the panoramic camera are simply spliced, and then the live images are spliced. After the splicing is completed, it is fused with the plane images designed by CAD to form a plane panoramic image

and output it. When the binocular parallax stereo display technology is used, when the human eyes see the same image, the two eyes present different images in front of each other, so the images seen by the two eyes are displayed separately. At a certain moment, the corresponding left-eye view is transferred to the first camera, and the corresponding right-eye view is transferred to the second camera, and then the two images are analyzed and processed in depth using true 3D stereo display technology, combined with the processed image, and finally the 3D stereo image is displayed [21-22].

### *2.3.3 Step 3: Optimize 3D stereo image*

According to the different optimization space, image enhancement technology contains two image optimization methods, which are space-based and frequency-based methods. The frequency-domain method is to optimize each virtual pixel on the three-dimensional stereo image, and the optimization content includes image smoothing and histogram correction. The spatial domain method refers to the conversion of 3D stereo images into another spatial domain through the gray-scale transformation method, and then the optimization of 3D stereo images stored in another spatial domain through the Fourier transform method. In order to improve the quality of 3D stereo images and the effect of image transmission, the depth optimization of 3D stereo images is carried out by combining the spatial prediction method with the frequency domain method.

## 3 RESULT ANALYSIS

In this paper, the effectiveness of this system is verified by comparing with the traditional system. The actual image transmission results and the image transmission results of the two systems are shown in Figure 6. Where:

Communicate correct percentage = (Total number of communications-Number of communication errors-Number of missing communication)/(Total number of communications)*100%

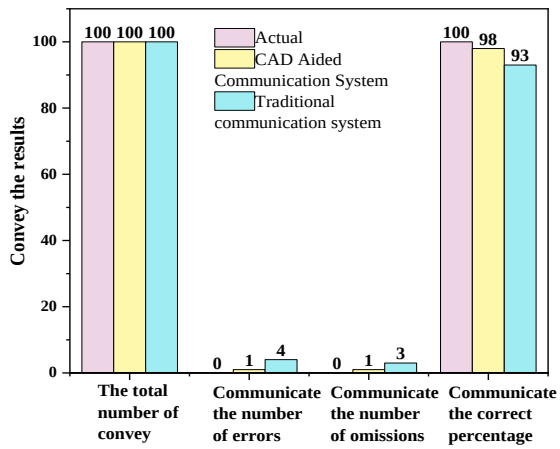


**Figure 6**: Communicating results.

It can be seen from Figure 6 that the image transmission effect of the system in this paper is basically the same as the actual transmission effect, with only two cases of inconsistent transmission, high transmission accuracy and low error rate. However, the image transmission effect of the traditional digital system is quite different from the actual transmission effect. There are 4 misreports and 3 misreports. The image transmission effect is poor, the transmission accuracy is low, and the misjudgment rate is large [23].

In addition, the traditional image transmission automatic digital system can only design a single element, and it is difficult to design multiple elements, and the lack of image order relationship in the process of automatic image transmission leads to the low efficiency of the traditional system to convey image information. Three-dimensional stereoscopic images are processed by binocular parallax stereoscopic display technology, the image is analyzed in depth by true three-dimensional stereoscopic display technology, and the displayed three-dimensional stereoscopic images are optimized by image enhancement technology. Fourier transform method and gray transform method are used to improve the quality of three-dimensional image and the effect of image transmission, and then improve the efficiency of image information transmission of the system. In order to compare the efficiency of image information transmission between the traditional system and the system in this paper, comparative experiments are carried out to verify. The results are shown in Table 1.

| *Information content/gb* | *Cad aided communication system* | | *Traditional system* | |
|---|---|---|---|---|
| | *Identification efficiency%* | *Delivery efficiency%* | *Identification efficiency%* | *Delivery efficiency%* |
| 20 | 99.56 | 97.85 | 85.26 | 82.39 |
| 40 | 99.51 | 98.25 | 86.45 | 82.33 |
| 60 | 99.48 | 97.6 | 87.39 | 81.45 |
| 80 | 99.39 | 98.53 | 86.25 | 84.31 |
| 100 | 99.25 | 98.66 | 87.41 | 85.69 |
| 120 | 99.36 | 99.25 | 88.24 | 86.45 |

**Table 1**: System performance test results.

It can be seen from Table 1 that the efficiency of the automatic digital system of image transmission based on CAD technology designed in this paper is far higher than that of the traditional automatic digital system of image transmission, the efficiency of image information transmission has increased by 15.4%, and the accuracy of image information transmission has increased by 12.1%.

## 4 CONCLUSION

To sum up, the image transmission automation digital system based on CAD technology designed in this paper is superior to the traditional system. The image transmission effect is better, the accuracy is higher, there is no missing report, and the efficiency of transmitting image information is far higher than the traditional system, the system performance is better, and has certain application value.

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