





Computer Aided Art Design and Production Based on Video Stream

Sufen Guo¹  and Xueguang Li² 

¹School of Fine Arts, Xinxiang University, Xinxiang, Henan 453000, China, quosufen122@126.com

²The 22th Research Institute of China Electronics Technolgy Group Corporation, Xinxiang 453000, China, lixueguang002@126.com

Corresponding author: Sufen Guo, quosufen122@126.com

Abstract. With the continuous development of informatization, digital video is increasing sharply every moment. Multimedia information represented by video streams has gradually become the main form of information media in the field of information processing. This paper proposes a method of directly extracting I-frames in the compressed domain, which overcomes the shortcomings of traditional video retrieval algorithms that decompress video files before processing. From the point of view of the scene, it discusses how to synthesize the scene summary using I frames to obtain the smallest computer-aided unit in the video. The new model promotes the information transformation of art design activities, provides excellent theoretical tools for the extension of digital network to art design, and creatively brews a digital network learning platform based on network sharing. The new model applies the advantages of computer technology to the design of art categories, promotes the sound and orderly development of art design, and improves the professional level of art designers and producers. The new model was tracked and analyzed by means of work research and judgment, and the results showed that the effect of computer-aided art design and production model design was significant.

Keywords: Art design and production; computer aided; video streaming; frame extraction

DOI: <https://doi.org/10.14733/cadaps.2021.S3.70-81>

1 INTRODUCTION

As a very comprehensive art creation, computer-assisted art involves many types of art, and on the basis of following the unique rules of computer-assisted art, a second creation is carried out. Computer-aided art is an important part of opera and drama, including lighting installations, design platform scenery, costume makeup, drawing props, and sound adjustment [1]. It is based on the basic form of the director and screenwriter writing the content of the script and putting

forward the requirements of the performance, and it is necessary to make sure to use a variety of creative methods of plastic art on the basis of satisfying a unified artistic concept to create the desired expression [2]. A parallel and interactive form of creation in space and time is also a unique form of art creation in computer-aided art design [3].

In China, there are still few books on the corresponding research on video streaming technology. Many books only conduct unilateral research on video streaming technology or computer-aided art design. Many articles also confuse video streaming technology and video streaming art [4]. With the development of video streaming technology, more and more designers are also aware of its impact on the creativity and effects of computer-aided art [5]. It can also make computer-aided art designers bolder in their creations and allow the audience to experience, leaving a huge room for imagination. The traditional design platform is very limited. After the use of video streaming technology, the design platform and designers can be not limited to a certain scene, and the scene can change rapidly, reflecting the narrative style of montage, and perfecting the narrative methods such as drama and opera [6]. Looking back at the development history of video streaming art for nearly half a century, it is not a fixed vocabulary, but is constantly changing with the advancement of technology and the development of science. It appears in different historical periods in different appearances. In front of us is a brand-new subject with a comprehensive and interdisciplinary feature. Sabo [7] has discussed that cyberspace expands the dimensions of space and time, and proposed that time is the fourth dimension added to the three-dimensional space, which links time and space together, just as the author said that space has the dimension of time. It always happens in time. Information technology is now gradually making us face the development trend of art and even the entire culture. Gale [8] regards the media as the main motivation and believes that the media is a hidden force that shapes history and society, which is often overlooked. This is a failure of "written culture" or Western perception. Written culture is obsessed with the content of the media. It must be innovated in the new electronic environment. Juliff and Early [9] proposed that we abandon our old habits of thinking and adopt new standards of perception and knowledge. They pushed the interpretation of media to a new level. Huang et al. [10] pointed out that with the development of new technologies, new communication channels and new creative media, new technologies and new methods have been brought to art. Interaction, multimedia or cross-media constitute the characteristics of art in the digital and information age. Nikolakis et al. [11] pointed out that the development of video streaming art depends to a certain extent on the influence from the technical field at different stages, and the evolution of the concept and form of video streaming art is parallel to the development of technology. Benetti et al. [12] pointed out that the emergence of the Internet and interactive devices gave birth to new forms and expressions of drama. In the definition of "digital design", it mainly includes all design works that have played a key role with computer technology.

Several key technologies of computer-aided video retrieval are studied. A frame model based on computer-aided video retrieval is proposed, MPEG-2 coding technology is analyzed in detail, and an I frame extraction method based on the compression domain is proposed. On this basis, the I frame is modeled for the information system, the shot is divided, the key frames in the shot are extracted, and the information system is further established for the key frames, and then the scene summary is synthesized based on the I frame. For the realization of the computer-aided art design program, the theoretical design of the research program based on computer-aided art design was carried out, and ASP.NET, SQLServer 2005, Macromedia, Dreamweaver and other technologies were used to construct the course framework of "computer-aided art design". Based on the computer digital network learning platform, the realization of computer-aided art design schemes is carried out.

2 VIDEO STREAMING COMPUTER-AIDED ART DESIGN METHOD

2.1 The Characteristics of Video Stream Computer-Aided Art Design

The development of digital information technology has opened up a new horizon for narrative. The content of digital text is arranged in the order of time instead of spatial distribution, thus completely interpreting the relationship between time and space of narrative. Traditional narrative is characterized by linear narrative. The beginning, the passage, and the end of the story are in the same line. Time is the benchmark that guides the development of the story. But in the narrative of video streaming art, time does not assume the guiding role of traditional narrative. The past, present and future can be overlapped and intertwined. The linear time is decomposed into time fragments, just like watching a traversal drama watching now, forming an endless sense of traversal. The computer-aided video retrieval system structure diagram is shown in Figure 1.

In the video stream computer-aided art design, influenced by the non-linear narrative technique of montage, its narrative technique is no longer a closed. Instead, it shows a leap-like dynamic development process, paying more attention to the interpretation of the narrative context and the analysis of the narrative process, and the emphasis is on the audience's imagination and participation. The non-linear narrative method creates a multi-dimensional perspective, with two levels, one is multi-angle in space, and the other is multi-level in time. Space no longer has boundaries, and time is no longer a single line. When the concept of time is integrated into the three-dimensional space of the design platform, a four-dimensional space is formed. In this four-dimensional space, the temporality of the story is explored in the form of space. From this, continuation, coexistence, traversal, and deconstruction form the unique experience of the video stream design platform.

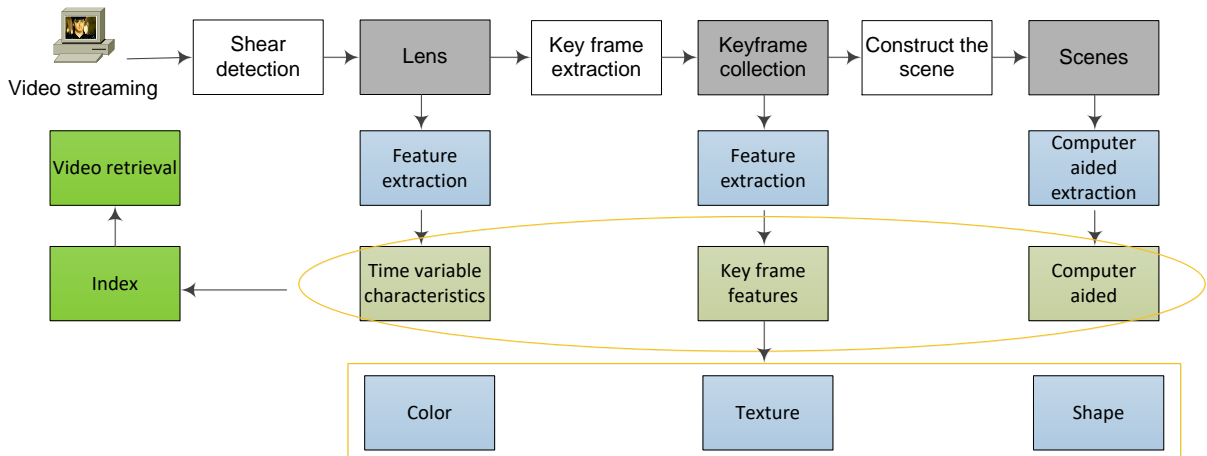


Figure 1: Computer-aided video retrieval system structure diagram.

Virtuality and reality are a pair of opposite but closely connected contradictory relationships. The reality of the design platform refers to the design space that exists objectively in the performance venue, while the virtual space includes the real space outside the performance venue and the abstract space in the design platform. Traditional computer-aided art design expresses virtual space through the designer and designer's rhetoric, while video stream computer-aided art design uses technical means and non-linear narrative forms to create a visual virtual space that allows viewers to design platform design, visual images and Hearingly constructs a virtual space.

2.2 Creative Principles of Video Stream Computer-Aided Art Design

In the era of video streaming art, the involvement of video streaming art in computer-aided art has caused a fundamental change in the attributes of the design platform. On the one hand, the design platform is no longer a venue in the traditional sense. The media concept of video streaming art is integrated into the computer-aided art design. The design platform has also become a medium, taking on the task of transmitting information. On the other hand, the demands of video streaming art with "life-oriented aesthetics" and "art popularization" as the core have also been absorbed by computer-aided art design, gradually affecting the creation of computer-aided art. No matter from the perspective of the nature of the design platform or the perspective of the concept of the design platform, the word "person" is commonly mentioned.

Audience is the core issue of the design of the video stream design platform. Therefore, we can strengthen its guidance from three aspects: First, following the audience is the source of artistic creation. The delivery of video stream art is a process of decoding. The audience is the standard to measure the effectiveness of decoding. For example, the development process of computer-aided art design is precisely due to the changes in the audience's aesthetic consciousness and values that promote its development. Secondly, you conduct audience analysis to find out the differences and common features of the audience groups. The audience group is a complex group, and different audience groups have different demand characteristics. Therefore, the audience is analyzed and understood in order to understand the audience more comprehensively, so as to provide an objective and reliable basis for computer-aided art design. Finally, you locate the behavior motivation and psychological needs of the audience. Human psychology and behavior are closely related, and behavior arises from certain psychological needs to a certain extent.

In the video stream computer-aided art design, the audience participates and interacts with the design platform works. The ultimate goal of the design platform is to allow the audience to identify with the design platform works, resonate, and enjoy the beauty. This is an aesthetic process. Through perception and experience, associations are generated and a sense of immersion in the design platform is raised. In the video stream design platform, immersion is generated by the audience in the immersive experience. It is the audience experiencing the virtual environment, which can be visual or behavioral, and actively interact with the virtual space. In the process of interaction, an image state that is temporarily difficult to distinguish between the real world and the virtual world is produced. Immersion is the deepest level of audience participation in the design platform viewing activities. Therefore, video stream computer-aided art design should be based on the principle of creating a sense of immersion.

2.3 The Realization Path of Video Stream Computer-Aided Art Design

The audience-oriented principle of video stream computer-aided art design requires audience analysis to be carried out in its realization path, and firstly, it is necessary to understand the audience of information. According to the group and difference of the audience, the audience can be analyzed in terms of audience type and demographic characteristics.

As an individual, because the audience has more or less differences in background, culture, economic conditions, etc., which have caused many different places, the audience has the characteristics of diversity, extensiveness, complexity, and concealment. It can be analyzed according to its psychological and behavioral characteristics. First, we can understand the audience's mental activity process based on the audience's common psychological characteristics of cognition, curiosity, conformity, performance, empathy, and attack. Secondly, according to the audience's motivation, status, media contact frequency and their loyalty, the audience's behavior characteristics can be analyzed to understand their behavior preferences and behavior patterns.

Therefore, the analysis of the audience is often not a simple one variable, but two or more variables need to be collected. Because it is difficult to get a comprehensive and clear

understanding of the characteristics of the recipient under the condition of one or two variables. Therefore, for the design platform audience under the video streaming art, it is necessary to use two or more variables to analyze the audience and understand the audience in order to better convey the information.

Art comes from life, and every work of art is imprinted with the brand of the times. At the same time, the content of the artwork also reflects the psychological emotions of people in that era. In the Internet age, people's aesthetic forms have changed, and traditional design platform art works develop and change with the changes in people's aesthetic forms under the background of the new era.

3 VIDEO FRAME EXTRACTION AND SCENE SUMMARY SYNTHESIS

3.1 MPEG-2 Compression Coding

The Moving Picture Expert Group (MPEG) organization was initially authorized to formulate various standards for the encoding of "moving pictures", and then expanded to "its accompanying audio" and its combined encoding. Later, in response to different application requirements, the restriction of "used in digital storage media" was lifted, and it became an organization that now formulates "moving image and audio coding" standards. So far, MPEG is the most popular and most used compression technology in the field of video compression. It includes several series such as MPEG-1, MPEG-2, MPEG-4, MPEG-7 and MPEG-21. The main analysis here is the MPEG-2 video compression coding standard.

Compared with MPEG-1, MPEG-2 not only has downward compatibility with MPEG-1, but also adds many new features, which are mainly reflected in the following aspects:

- 1) The video source format supports progressive scan format, as well as interlaced scan format.
- 2) The concept of grade and level is defined as a subset of its complete syntactic flow.
- 3) They provide a scalable bit stream, so that decoders of different capabilities can decode and display video signals with different time/spatial resolutions and different quantization steps from the same bit stream as needed.
- 4) Since interlaced scanning is allowed, the concept of frame picture and field picture is introduced, and several prediction modes different from progressive scan video are specified.
- 5) In order to improve the image quality, the quantization and coding methods are extended.

The video structure of MPEG-2 is shown in Figure 2.

3.2 Frame Coding Algorithm

The I frame is an intra-frame coded image, which refers to an image that does not need to be predicted with other reference frames during encoding, that is, it does not need to refer to the image that has been coded in the past, and it does not need to refer to the subsequent image that has not been coded, so the intra-frame coded image does not consider the temporal correlation of images.

I frame compression uses the reference frame mode, does not refer to any other past or future image frames, and only provides intra-frame compression based on DCT transformation. If the video image is expressed in RGB space, it is first converted into an image expressed in YCr Cb space. Each image plane is divided into 8*8 blocks, and discrete cosine transform is performed on each block. The quantized AC component coefficients after DCT transformation are sorted according to the shape of Zigzag, and then encoded using lossless compression technology. After DCT transformation, the quantized DC coefficients are coded with differential pulse coding (DPCM),

and the AC component coefficients are coded with run length coding (RLE), and then Huffman coding or arithmetic coding is used. The coding block diagram is shown in Figure 3.

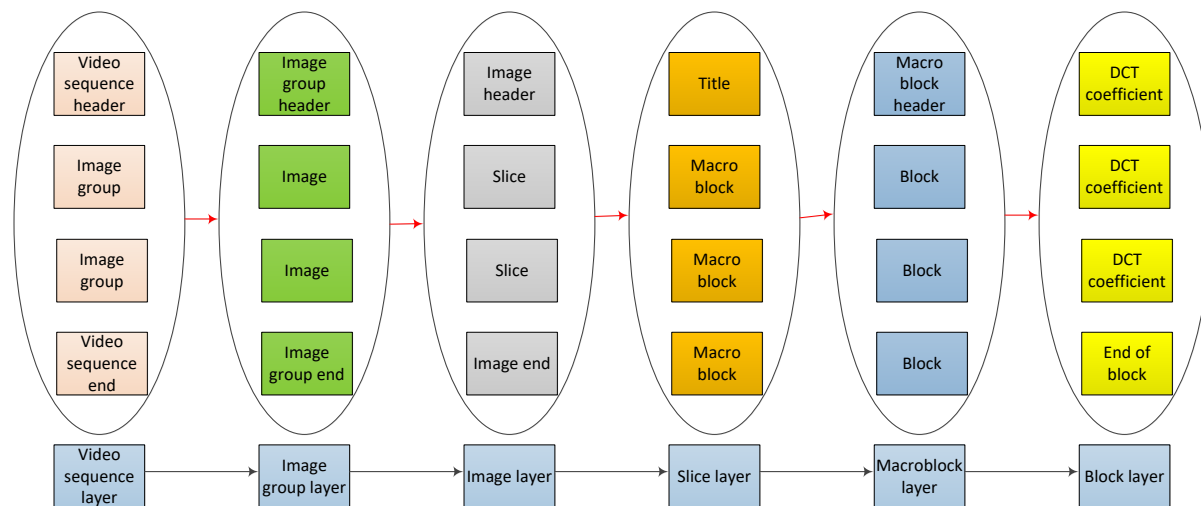


Figure 2: MPEG-2 video structure hierarchy diagram.

The compression of the I frame can only remove the spatial redundancy within the frame, and the compression ratio reaches 6:1 without any noticeable blurring. It is the reference point for motion estimation required to generate the subsequent P and B frames. I frame provides the most advanced random-access function.

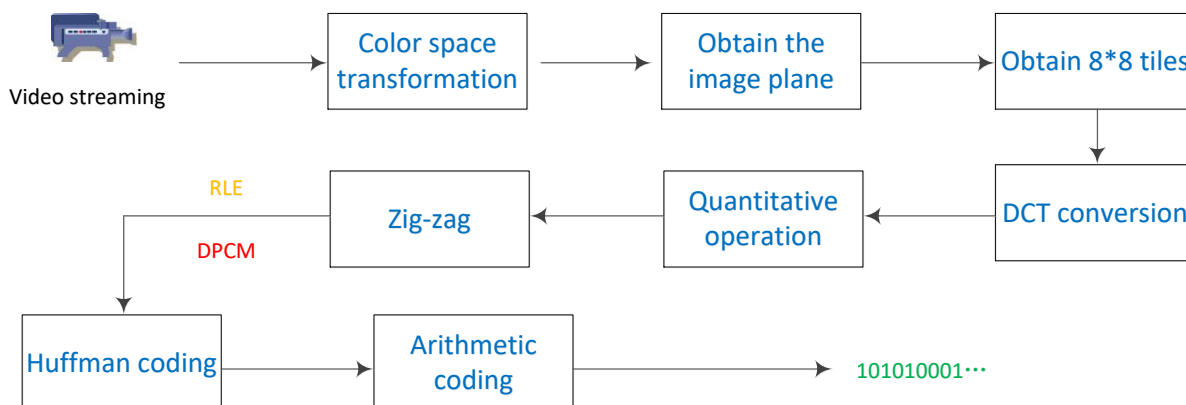


Figure 3: I image compression coding algorithm flow.

3.3 Synthesis of Scene Summary

Any video summarization algorithm follows a "divide first, then combine" principle. To understand and analyze video content, you must first divide the video into reasonable basic units. These basic units include scenes, shots, key frames, etc.

According to the international standard of MPEG video compression, the binary stream is transmitted in the video transmission process. DCT coefficients can be directly extracted from the binary video stream, and DC coefficients (DC coefficients or low-frequency coefficients) can be obtained by preprocessing the DCT coefficients.

For a video file, first we extract the I frame from the video stream, obtain the DCT coefficient of the I frame, and obtain the DC coefficient after preprocessing; then, use the DC coefficient as the row and the I frame as the column to model the information system (two-dimensional table). In the information system, you compare the average value of the sum of the absolute values of the differences of the DC coefficients of the corresponding blocks of two adjacent frames, and compare with the given shot threshold, thereby dividing the video sequence into shot sets; further to the information system using RS theory to perform attribute reduction to obtain the core of the information system, it can be understood as a relatively redundant I frame, that is, a key frame, which reflects the main content of the shot.

4 THE REALIZATION OF COMPUTER-AIDED ART DESIGN AND PRODUCTION MODE

4.1 Model Characteristics of Computer-Aided Art Design and Production Mode

For colleges and universities, the art design plan is a professional-level art course system. The goal of the curriculum establishment of the system is to enable learners to master the relevant art theory and artistic aesthetic characteristics, so that learners understand the basic professional knowledge of art general knowledge, and through the above learning, learners initially master the general methods and realization of art creation and design skill.

Based on the computer-aided art design and production mode, the digital network learning platform technology is used to realize the design activities, so its curriculum plan has the following main characteristics.

1) The computer-aided art design and production model has a comprehensive nature of interdisciplinary and interdisciplinary. Computer-aided art design conforms to the characteristics of applied design technology, and the model involves knowledge of multiple disciplines, including knowledge fields such as modern computer technology, modern design concepts, and artistic aesthetics.

2) The computer-aided art design and production model has a comprehensive nature with multimedia characteristics. The design courses of computer-aided art design are embodied in the forms of graphics, video images, text layout, etc. The design courses are presented through a digital network learning platform, with vivid images, vivid pictures and texts, bright colors, and intuitive and prominent visual impact.

3) The computer-aided art design and production mode has the applicability of interactive and smooth. Due to the intervention of computer-aided design technology, the course design methods of computer-aided art design are not limited by practical limitations. Multi-angle and multi-factor communication and discussion are formed through the Internet. It has the characteristics of different participants and a wide range of people.

4) The computer-aided art design and production model has more advanced design methods than before. Computer-aided art design uses a large number of modern digital design techniques and uses the advantages of modern technology to carry out knowledge dissemination. Its methods reflect the advantages of contemporary digital technology such as information digitization, speed of light transmission, and diversification of participation.

The computer-aided art design and production mode uses the art design form in the new modern environment, conforms to the development trend of the current digital age, and gives a useful attempt to change and improve the traditional art design. Based on the computer-aided art design and production mode, it can be said that this is a new design concept and method bold try.

The sample video stream evaluation results of the user terminal at 500kbps are shown in Figures 4 and 5.

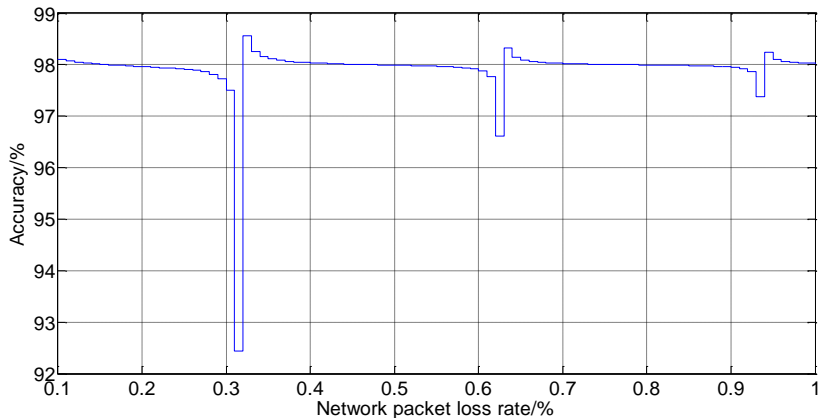


Figure 4: Evaluation result of sample video stream of user terminal in static state at 500kbps.

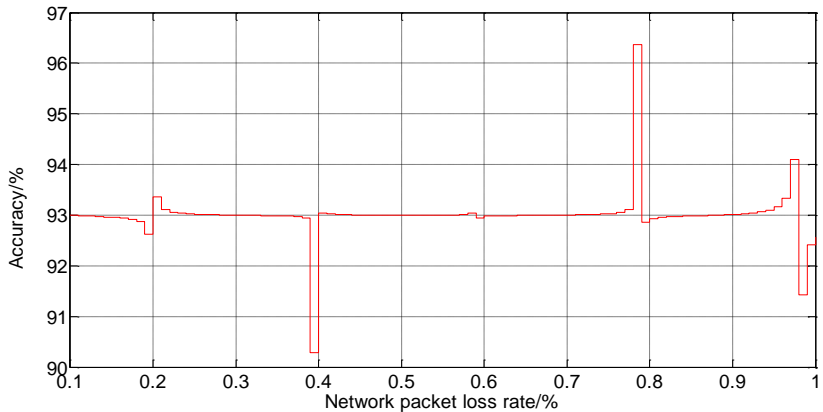


Figure 5: Evaluation result of sample video stream of mobile user terminal at 500kbps.

4.2 Platform System of Computer-Aided Art Design and Production Mode

The curriculum plan of computer-aided art design is constructed according to its model. This part focuses on the design plan based on the digital network learning platform, and elaborates the curriculum plan based on computer-aided art design. The computer-aided art design course framework mainly embodies the combination of art and computer technology. Fine arts use computer technology to better promote the development of aesthetic design; and the support of fine arts to computer technology promotes the continuous birth of new computer technologies. The framework of the computer-aided art design course is shown in Figure 6.

The system management module plays the role of platform service. After the administrator registers and manages, the relevant information such as the qualification information of the designer and producer and learner will be entered in the system, and stored and managed in the system database.

The platform login module consists of five parts: design and producer registration module, design and producer management module, learner registration module, learner learning module, and participant module.

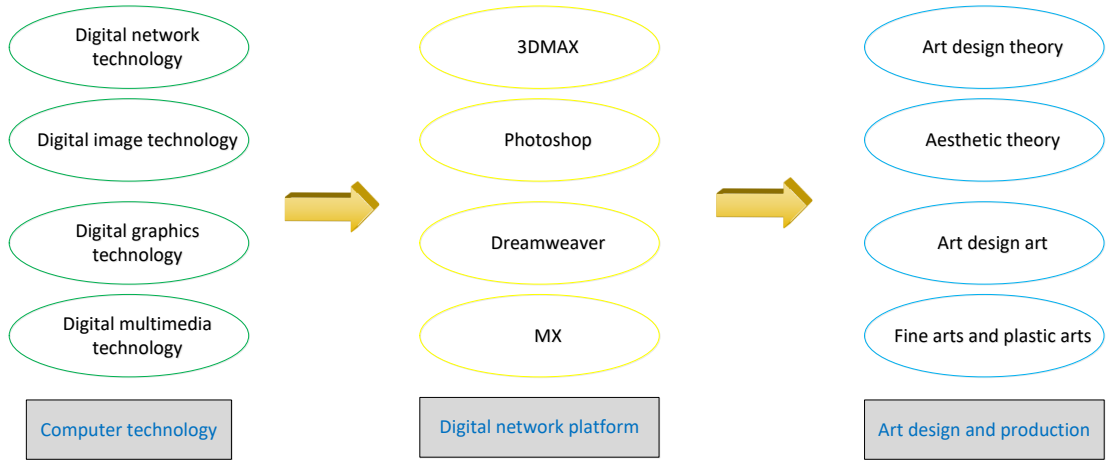


Figure 6: Curriculum framework of computer-aided art design.

4.3 Streaming Media and Dynamic Web Pages

In this system, streaming media technology is widely adopted. Current streaming media technologies mainly include Microsoft's Windows Media Technology technology, Apple's Quicktime technology, and Real Networks' Real Media technology. Because the server of this system adopts Windows 2005 Server, it already contains streaming media components with complete tools. At the same time, a streaming media browser is also integrated in the Windows operating system. Therefore, this system mainly uses Microsoft's Windows Media Technology in the production process.

The front desk of this system uses a large number of Java Script scripting language and Cascading Style Sheets (CSS) styles. CSS can more accurately control the font and graphic effects of the front page. Figure 7 shows the comparison of the number of frame damages in the sample video stream.

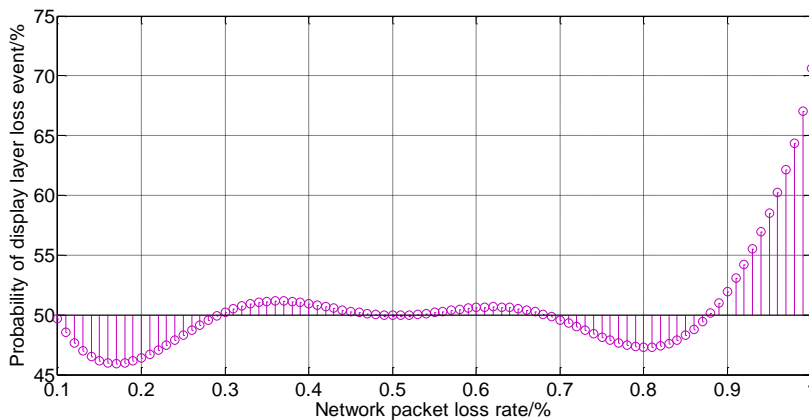


Figure 7: Comparison of the number of sample video stream frame damage.

4.4 Design and Producer System Management

Designers and producers carry out management of platform courses in this module, and carry out supervision and management of learners' research learning process. The proportion of each module is shown in Figure 8.

The main functions of the art topic information module include providing designers and producers with art topic creation plans, management tasks for art topic design arrangements, and timely updates. The main functions of the art project announcement module include the relevant content of the research study of the designer and the producer through the art project, including the creation information of the art project project, the evaluation topic selection information, etc., and the task is issued to the learners through this module.

The main functions of the art course handout design module include the provision of art professional course handouts based on a digital network learning platform for designers and producers, including course document tutorials, course video handouts, course project demonstrations and other related materials that conform to the characteristics of the online course.

The main function of the art project achievement resource module is to provide designers and producers with learning resources for art project research learning and related materials such as the results of past uploaded projects.

The main function of the art subject learning management module is that designers and producers use this module to professionally guide and manage the creation and research of learners' art subject projects. The scientific system tracks and manages the progress of learners' investigative learning, discovers problems in time, and gives promptly.

The main function of the communication feedback module of the art course is that the designer and producer can answer the difficult questions of the learner about the art project through this module. The designer and producer can communicate with the learner online asynchronously.

The main function of the integrated art management module is that designers and producers use this module to master learners' online login access, online learning, and learning log information.

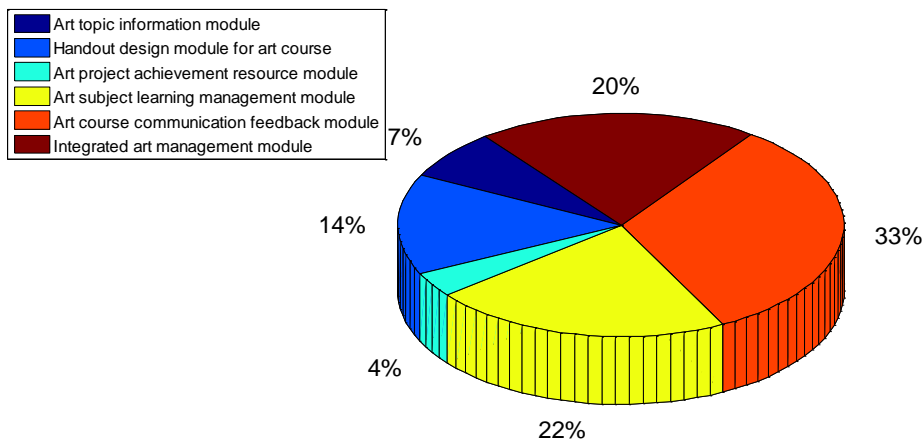


Figure 8: Proportion of each module.

5 CONCLUSION

To analyze the video structure in the compressed domain, it is necessary to extract the I frame, because the I frame records the main information of the image. With the I frame, we can use the I

frame to perform lens segmentation, key frame extraction, scene summary synthesis, and so on. This paper proposes an I-frame-based scene summary synthesis algorithm. The algorithm uses the I-frame DCT coefficients in the database to model the information system. Through attribute reduction, shots are divided, key frames are extracted, shots are classified, and the scene summary is finally synthesized. This article has carried out the practice of research learning on the computer-aided art design platform, and conducted research and evaluation on it. Through the practical application research based on the digital network learning platform, it is fully concluded that the factors that reflect the research are mainly the nature of the professional topics taught by the designer and the producer and the guiding mechanism. In addition, the learners' Internet learning awareness and information collection capabilities, as well as the size of the learning team's participation in the project and the evaluation effect are also crucial. These factors promote the formation of computer-aided art design and production mode, so that the design and production mode creates a broad development space for research design.

Sufen Guo, <https://orcid.org/0000-0001-9940-5857>

Xueguang Li, <https://orcid.org/0000-0001-6322-1650>

REFERENCES

- [1] Lee, I.; Tester, J.-W.; You, F.: Systems analysis, design, and optimization of geothermal energy systems for power production and polygeneration: State-of-the-art and future challenges, *Renewable and Sustainable Energy Reviews*, 109, 2019, 551-577. <https://doi.org/10.1016/j.rser.2019.04.058>
- [2] Klumpp, M.; Hesenius, M.; Meyer, O.; Ruiner, C.; Gruhn, V.: Production logistics and human-computer interaction—state-of-the-art, challenges and requirements for the future, *The International Journal of Advanced Manufacturing Technology*, 105(9), 2019, 3691-3709. <https://doi.org/10.1007/s00170-019-03785-0>
- [3] Dolgui, A.; Ivanov, D.; Sethi, S.-P.; Sokolov, B.: Scheduling in production, supply chain and Industry 4.0 systems by optimal control: fundamentals, state-of-the-art and applications, *International Journal of Production Research*, 57(2), 2019, 411-432. <https://doi.org/10.1080/00207543.2018.1442948>
- [4] Mourtzis, D.: Simulation in the design and operation of manufacturing systems: state of the art and new trends, *International Journal of Production Research*, 58(7), 2020, 1927-1949. <https://doi.org/10.1080/00207543.2019.1636321>
- [5] Calzavara, M.; Battini, D.; Bogataj, D.; Sgarbossa, F.; Zennaro, I.: Ageing workforce management in manufacturing systems: state of the art and future research agenda, *International Journal of Production Research*, 58(3), 2020, 729-747. <https://doi.org/10.1080/00207543.2019.1600759>
- [6] Marteel-Parrish, A.; Harvey, H.: Applying the principles of green chemistry in art: design of a cross-disciplinary course about 'art in the Anthropocene: greener art through greener chemistry', *Green Chemistry Letters and Reviews*, 12(2), 2019, 147-160. <https://doi.org/10.1080/17518253.2019.1609595>
- [7] Sabo, S.: Conflict zones: labor and cultural exchange in the production of contemporary art textile works, *Journal of Textile Design Research and Practice*, 7(1), 2019, 104-123. <https://doi.org/10.1080/20511787.2019.1592358>
- [8] Gale, C.: Art school as a transformative locus for risk in an age of uncertainty, *Art, Design & Communication in Higher Education*, 19(1), 2020, 107-118. https://doi.org/10.1386/adch_00016_1
- [9] Juliff, T.; Early, J.: The self-design of contemporary confessional art, *Journal of Visual Art Practice*, 18(4), 2019, 342-358. <https://doi.org/10.1080/14702029.2019.1676994>

- [10] Huang, S.; Potter, A.; Evers, D.: Social media in operations and supply chain management: State-of-the-Art and research directions, *International Journal of Production Research*, 58(6), 2020, 1893-1925. <https://doi.org/10.1080/00207543.2019.1702228>
- [11] Nikolakis, N.; Alexopoulos, K.; Xanthakis, E.; Chryssolouris, G.: The digital twin implementation for linking the virtual representation of human-based production tasks to their physical counterpart in the factory-floor, *International Journal of Computer Integrated Manufacturing*, 32(1), 2019, 1-12. <https://doi.org/10.1080/0951192X.2018.1529430>
- [12] Benetti, D.; Liang, L.; Rosei, F.: Nature and Chinese art inspire materials for light harvesting, *Matter*, 3(1), 2020, 24-26. <https://doi.org/10.1016/j.matt.2020.06.005>