Optimization of Classroom Teaching Quality Based on Multimedia Feature Extraction Technology

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ABSTRACT

In this article, the research of multimedia teaching video content feature extraction is carried out. According to the file structure, data type, and storage mechanism of the teaching video, a program is developed to automatically extract the structural features of the teaching video content, and a storage and retrieval database is established. The research results show that the accuracy rate of various videos compiled through genie 8.0 for teaching videos exceeds 94%. The recall rate of various videos exceeds 95%. The accuracy and recall of advertisements have reached 100%. Among the elements of teaching video content features, the number of graphs is the highest, followed by film clips, accounting for 14.18. Image, vivid, and interactive multimedia teaching video technology has greatly improved teaching effectiveness, promoting students to better understand and remember knowledge points. The research results provide theoretical data support for multimedia feature extraction to optimize classroom teaching quality.

KEYWORDS

extraction technology, multimedia features, storage structure, teaching quality

INTRODUCTION

The key to educational reform and innovation lies in classroom teaching. Only by actively building students' enthusiasm can the quality of classroom teaching be effectively improved (Nie, 2020). With the rapid development of computer networks, multimedia technology has been widely used in the field of education, which has changed traditional teaching methods and enhanced students' interest in learning (Deng, 2022). The use of multimedia technology in teaching can make scientific problems dynamic, simple, and real; can constantly stimulate students' interest in learning; and can cultivate their innovative consciousness and ability (Zang, 2021). Multimedia network video teaching is a digital network teaching resource. With the development of multimedia technology, video teaching resources have become increasingly rich (Wang & Moulin, 2007). A popular area of research is how to quickly retrieve and utilize teaching video resources in order to maximize their benefits (Gu & Li, 2021).

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The research on multimedia feature extraction technology has achieved certain research results. Some researchers have studied the use of web-related text technology to extract keywords from multimedia educational videos and retrieve multimedia information. Because of the rich characteristics of multimedia information, it is difficult to describe it with a few simple keywords (Bai et al., 2018). At the same time, the existence of keywords automatically retrieved may not match the multimedia content, resulting in poor keyword retrieval results; in turn, teachers still need to spend a lot of time choosing, which greatly reduces the efficiency of using multimedia information (Zhang & Wang, 2022). The main reason for this phenomenon is that search engine systems do not have sufficient depth in indexing multimedia information content. Therefore, the content-based multimedia information retrieval technology developed after the 1990s solves retrieval problems from the content level of multimedia information, improves retrieval accuracy, and avoids subjective one-sidedness and incompleteness caused by textual descriptions. Some researchers propose the hierarchical division of multimedia content to solve the problem of inaccurate retrieval (Dai, 2022). By automatically analyzing multimedia information content, low-level audio-visual features such as color of video image, and tone of sound are extracted, and middle-level object features and high-level theme features are obtained based on pattern recognition technology (Wang & Han, 2021). These rich features are used to retrieve multimedia information, which solves the one-sidedness and incompleteness of text retrieval. Some researchers have studied the extraction of multimedia content features; defined the description and extraction of multimedia content features as the basis of information retrieval; put forward image retrieval, audio retrieval, video retrieval, and follow-up information retrieval of content; and carried out the extraction of multimedia content features around multimedia images, audio, and video. Some researchers propose FLAME's teaching video content retrieval method, which divides the characteristics of teaching video content into three features—namely, the media object, various events, and human-computer interaction characteristics of teaching video—and puts forward the presentation layer, index layer, and retrieval layer of the teaching video retrieval system. Teachers can use the retrieval system to search for the required teaching resources. Some researchers have proposed a retrieval method for teaching videos that establishes a model of space, movement, and interaction according to the components of videos and can realize the retrieval of small-scale video components. This method has a small number of elements, and the retrieval content is relatively simple, so it is difficult to meet the actual needs in the face of the complex and diverse content characteristics of teaching videos. Some researchers have studied the visual, structural, and thematic features of multimedia online teaching videos. By searching the keywords of teaching video images and videos through the Web, the content and structure of videos are automatically analyzed, the main features are extracted, an index database of educational video resources is established, and multimedia online teaching video resources are searched by conditional retrieval and fuzzy query methods, which provides a platform for efficient use of multimedia online video teaching resources. According to the characteristics of multimedia teaching, some researchers have analyzed its main advantages and existing problems and concluded that multimedia is the main auxiliary teaching method. Using multimedia technology flexibly and reasonably, effectively combining traditional teaching methods with multimedia technology, has achieved certain strengths and avoided weaknesses, played an auxiliary role in teaching, promoted students' hobbies and interests in learning, and continuously improved the quality of classroom teaching. Some researchers combine images, sounds, and words based on multimedia technology, which is beneficial to college physics classroom teaching, but has little influence on teaching reform. By studying the strategies of multimedia technology to reform college physics classroom teaching, teachers' cognition should be strengthened, and multimedia technology should be used reasonably to accelerate classroom teaching reform.

With the development of multimedia technology, multimedia is widely used in classroom teaching (Zhang et al., 2012). The teaching video is the main tool of digital teaching, and its rapid acquisition and application will directly affect the quality and efficiency of digital teaching. Teaching videos have the advantages of good interaction, simple production, small storage space, and convenient network transmission, and they have been widely used in education (Wu, 2021). However, teaching videos include a combination of image, audio, video, and text, and the low accuracy and efficiency of feature retrieval has become the main challenge. In this paper, the content feature extraction of multimedia teaching videos is studied. According to the storage structure and formation principle of teaching videos, the data information, components, dynamic effects, and interactive features of video are studied in video file format, and the structural feature extraction of teaching video content is proposed. The program is programmed to realize the automatic extraction of structural features of teaching video content, and the storage and retrieval database is established, which provides theoretical data support for the optimization of classroom teaching quality by multimedia feature extraction.

EXPERIMENTAL METHODS

Multimedia Features

With the rapid development of multimedia and network technology, there are more than 2 million teaching video resources, there are special teaching video production and application pages on the Internet, and the frequency of teaching video production technology exchange and website sharing is also increasing. Multimedia teaching resources are distributed on various websites and web pages and basically exist in three types. The first type is embedded as a component of a webpage, such as images, flash, and online audio and video playback. The second type can be freely downloaded through the anchor text link in the webpage. The third type exists in multimedia network databases, allowing retrieval and browsing but often requiring an account and password.

The data for this study is sourced from the national website for the construction of high-quality teaching courses in higher education institutions, which includes high-quality course websites at the undergraduate, vocational, and online education levels in all provinces from 2003 to 2010. In this study, 500,000 teaching videos have been downloaded (Sun et al., 2020). Through comprehensive analysis of these teaching videos, on the basis of analyzing the sharing of teaching video websites, teaching videos are divided into nine categories: teaching courseware, animation, MTV, advertisements, games, websites, greeting cards, virtual reality, and three-dimensional animation (Dong, 2022).

Through the teaching video, the human eye sees the characteristics of temporary stay—that is, the visual temporary stay characteristics of human eyes. When human eyes see a certain picture, it will be projected on the retina. When they look at other pictures through line-of-sight shift, the original picture will still stay for about 1/24 second. Therefore, if the frame rate of video is set to more than 24 frames per second, what human eyes see is a continuous video image. Video can be divided into two domains: time and space, and the time is divided into key frames and ordinary frames(Xie, 2022). Each frame carries a picture (Zhang & Wen, 2022), and if you play each frame continuously, you will see the picture contained in each frame. When there are many frames played per second, it will present a continuous and natural picture scene (Ramadan & Abdel-Kader, 2009).

Feature extraction of teaching videos is a systematic project, which mainly includes external features such as file name creation, storage type, time, size, and creator, as well as internal features such as data, elements, dynamic effects, and interactive features (Peng, 2022). As the most important part of feature extraction, the structural feature of teaching video content is the key to establish the internal relationship between feature base and index base, and it is also the most concise description of content features.

Multimedia Feature Database

The structural feature data and index database of teaching videos will be the key components of feature extraction programs and the core of searching teaching resources through video content, and its importance is self-evident (Liu et al.,2022). The feature database is mainly used to store the data of the structural features of teaching video content, and the index database is mainly used to store the data that can be directly retrieved and used by users after information processing. When the teacher inputs or selects the retrieval content, the retrieval system will automatically match the content structure characteristics of the index database according to the specific content input or selected by the teacher and retrieve the teaching videos that meet the user's retrieval requirements according to the matching results (Hu, 2021).

At present, the ACCESS database platform is mainly used to extract the structural features of teaching video content, which belongs to the most widely used database management system. The database is widely used by teaching departments because of its simple interface, high efficiency in later development, object-orientation, and secondary implantation (Liu, 2022). Table 1 shows the internal storage structure of the teaching video content structure feature database.

On the basis of storing the database, the storage structure of the index database is established, and the fields such as Web Path for storing web files, File Path for storing file paths, Keyword for storing keywords, Gif File Name for storing Gif file names, and Maincolor for storing main colors are added. The steps of extracting the structural features of teaching video content are as follows:

1. The system automatically reads the contents of the Local File Name field in the feature storage database and finds the corresponding teaching video according to the established file name;
2. By extracting the structural features of the corresponding content, the extraction results are stored in the corresponding field;
3. Teachers can input or select search keywords in the search system page, match them with the feature database, and display the search results on the front page of the search system, mainly including the fields such as Gif File Name, Web Path, and File Path.

EXPERIMENTAL RESULTS

Feature Extraction Platform

The teaching video content structure feature extraction platform is mainly divided into element extraction, dynamic effect extraction, and interactive feature extraction. On this basis, the teaching video file preprocessing module, content structure feature analysis module, and storage database

Table 1. Internal storage structure of teaching video content structure feature database

Field name	Field type	Illustration
Metadata	Figure	Frame number File size Video type
Constituent element	Figure	Picture Graph Audio Video Text Montage Button
Dynamic effect	Figure	Deformed Rotate Zoom Color change Move
Interactive feature	Figure	Button interaction Video clip interaction

module are formed (Shi, 2022). According to the elements, dynamic images, and interactive features of teaching videos, this paper will develop a program for extracting the structural features of teaching video content based on VC++8.0 software (Zhou, 2022).

Element extraction is mainly aimed at the metadata and components of teaching videos, including the frame number, video, audio, film clip, width, deformation, text, image, graph, and other information about the structural features of teaching videos. The element extraction results are stored in the feature database, and the element data of the feature database are informatized according to certain standards and principles and stored in the index database, so as to develop an element extraction platform.

The running program of the element extraction platform is to click the database button, select the teaching video database to be analyzed, display the characteristic information of the database teaching video on the platform interface, and check the accuracy of the database. Click the element processing button, and the platform will automatically judge the structural features of elements, display the extraction results of metadata and component information of teaching videos, and update the analysis progress in real time.

Dynamic effect extraction is mainly intended to extract the rotation, graph, color, scaling, and movement of teaching videos. Its extraction principle is the same as that of the element extraction platform, and its operation is simple. Just select the teaching video database and click Start Processing to display the results in real time.

Interactive feature extraction is intended mainly to extract buttons and movie clips. The process of data interactive feature extraction is complicated, but the design of the operation interface is simple and easy to operate. When the teaching video structure feature extraction platform completes the extraction task, the extraction results are stored in the feature and index database. Because there are many platforms in the teaching video, each platform has different characteristics and presentation methods. In this paper, different types of features are selected for the extraction of teaching videos on different platforms, and they are expressed in a certain way. Table 2 gives the extraction features of various platforms of teaching videos.

Analysis of Experimental Results

The accuracy of extracting structural features of platform teaching video content is mainly measured by recall and precision. In this paper, the collected teaching videos are divided into seven types: 3D, MTV, video, advertisement, courseware, website, and PPT, and 80 of them are randomly selected to form a total of 560 teaching video feature databases, which can be randomly selected and can play all teaching videos normally.

In this paper, the teaching videos of the experimental sample database are compiled by Genius 8.0, and the number of elements, dynamic effects, and interactive features of the teaching videos are manually marked. By comparing with the developed content structure feature extraction program, the precision and recall of the extraction platform are verified.

Genius 8.0 software is the mainstream teaching video processing software at present. Through this software, the teaching video can be compiled, the information of teaching video content can be

Table 2. Extraction features of teaching video from various platforms

Object	Extracted features
Text	Keywords, font size
Graph	Graph, color, number of sides
Picture	Image size, color, texture
Audio	Average intensity, frequency distribution, silence ratio
Video	Time structure, key frame feature, motion vector feature

displayed at any time, and various platform elements and scripts can be parsed to generate video files in FLA format. The software supports the interpretation of teaching video content structure elements, including images, graphs, scripts, and other features. By compiling FLA video source files, the precision and recall of the platform for extracting structural features of teaching video content are verified by taking manually marked elements, dynamic effects, and interactive features as control parameters. Precision rate = the number of content structure features correctly extracted by the platform/the total number of content structure features extracted by the platform. Recall rate = the number of content structure features correctly extracted by the platform/the total number of manually marked content structure features. When the precision and recall are both ≥80%, the content structure features developed in this paper have high accuracy and high use value.

Table 3 lists each of the video types. Figure 1 shows the comparison between the number of components correctly extracted by the platform and the total number of components extracted by the platform. Figure 2 shows the comparison between the number of components correctly extracted by the platform and the total number of components manually marked.

As can be seen from Table 3, Figure 1, and Figure 2, the precision of all types of videos is over 94%, the precision of advertisements is 100%, and the precision of websites and PPT is low, only

Table 3. Different video types

Classification	3D	MTV	Video	Advertisement	Courseware	Website	PPT	Sum
Number of components correctly extracted by the platform	4952	20321	32168	1987	17393	13271	16237	101377
Total number of components extracted by the platform	5074	20435	32435	1987	17658	13881	17127	103523
Total number of component elements manually marked	5021	20359	32387	1987	17601	13793	17058	103185
Precision ratio (%)	97.60	99.44	99.18	100.00	98.50	95.61	94.80	97.93
Recall rate (%)	98.63	99.81	99.32	100.00	98.82	96.22	95.19	98.25

Figure 1. Comparison between the number of components correctly extracted by the platform and the total number of components extracted by the platform

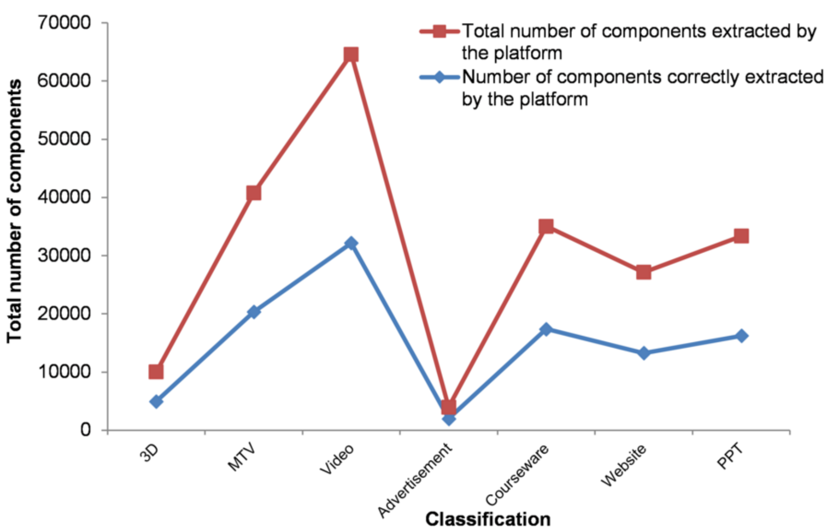
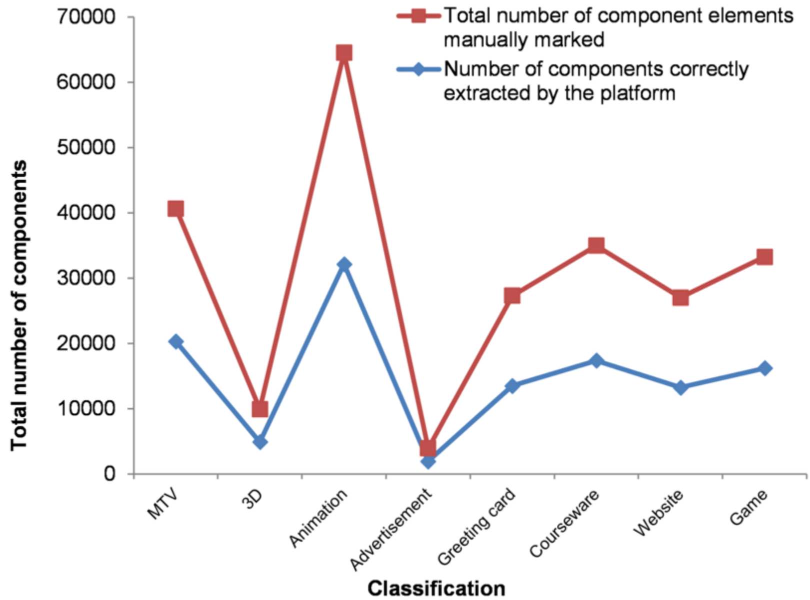


Figure 2. Comparison between the number of components correctly extracted by the platform and the total number of components manually marked



95.61 and 94.80, respectively. The recall rate of all types of videos is over 95%, and the recall rate of advertisements is 100%. Only PPT has a lower recall rate of 95.19%. This is mainly because these two types of video technology are not perfect, the number of resources is limited, and the extraction process is very complicated, which leads to low precision and recall.

Table 4 and Figure 2 show the number and proportion of each component in the teaching video content feature database, and Figure 4 shows the proportion of each component in the teaching video content feature database. As can be seen from Table 4, Figure 3, and Figure 4, among the elements of teaching video content characteristics, the number of graphs is the largest, accounting for 52.16% of the total number, followed by film clips accounting for 14.18%, followed by text accounting for 12.9%, which is mainly because teaching video belongs to vector video and will not be distorted after amplification. The proportion of other elements is less than 10%, and the number of buttons, audio, and video elements is small, which are 3.03%, 1.08% and 0.02%, respectively. It is rare to insert video directly into teaching videos, and there is usually only one or none in audio. There are many buttons in games and courseware, but few in 3D and MTV.

Influence of Teaching Video on the Quality of Classroom Teaching

Traditional teaching through blackboard, chalk, and textbook is gradually being replaced by teaching videos. This vivid and interactive multimedia technology greatly improves the effect of teaching and promotes students' interest in learning. Multimedia technology can visually present the important and difficult points of teaching, so that students can easily enter the teaching situation and master

Table 4. Statistics of the number of video components

Classification	Graph	Picture	Audio	Video	Text	Mask	Film Clips	Button
Quantity	51432	7564	1065	24	12721	8834	13982	2987
Proportion (%)	52.16	7.67	1.08	0.02	12.90	8.96	14.18	3.03

Figure 3. Number of each component in the teaching video content feature database

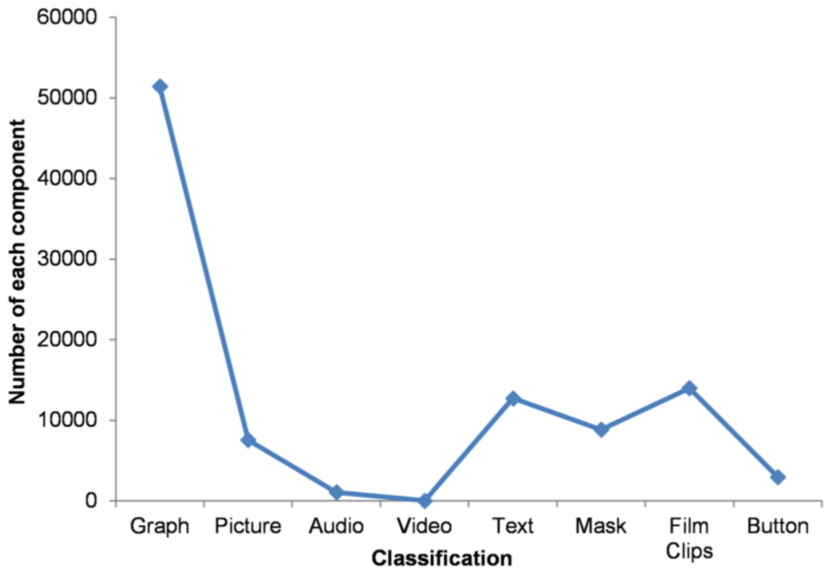
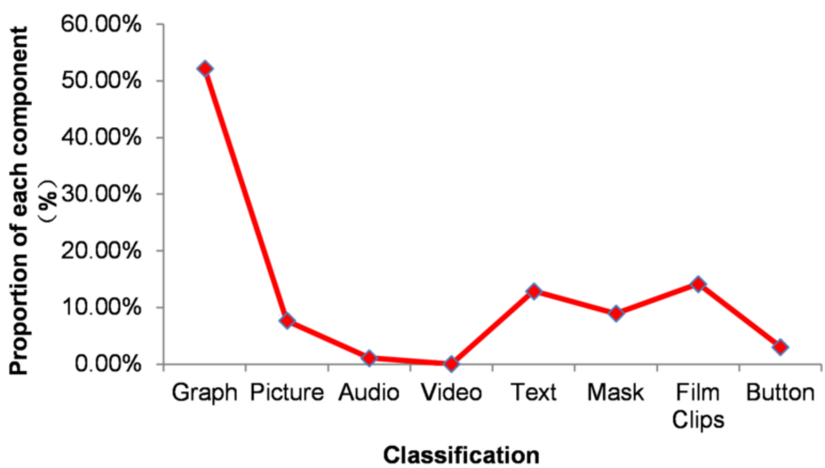


Figure 4. Proportion of each component in the teaching video content feature database



knowledge points. At the same time, the dynamic demonstration of teaching knowledge can turn abstract knowledge into concrete images and make it easier to understand. In teaching, students' initiative and enthusiasm are promoted, a good teaching platform is created, and students' learning ability is fully exerted and improved. By integrating audio, video, graphics, video, and text, teaching videos allow students to listen, speak, read, and watch knowledge in various ways, saving teachers' time and improving teaching efficiency. By organically combining abstract, difficult-to-understand, and important knowledge points with sounds, pictures, and texts, we can intuitively deal with abstract theories and complex spatial structures, stimulate students' interest, and help them to better understand and remember knowledge points.

CONCLUSION

With the development of multimedia technology, digital teaching methods such as MOOCs and micro courses have become the main methods of information education. This article presents research on feature extraction of multimedia teaching video content. This article adopts the ACCESS database platform, and on the basis of establishing a storage database, establishes a matching index database storage structure. The system automatically reads the content of the Local File Name field in the feature storage database and extracts the corresponding content structure features. Research has found that the precision of the teaching video content structure feature platform developed based on VC++8.0 software for all types of videos exceeds 94%, the precision of advertisements reaches 100%, and the precision of websites and PPTs is relatively low, only 95.61 and 94.80, respectively. The recall rate of various videos exceeds 95%, and the recall rate of advertisements reaches 100%. Only PPT has a low recall rate of 95.19%. Among the various elements of teaching video content features, the number of graphs is the highest, accounting for 52.16% of the total number, followed by film editing, accounting for 14.18%, and text, accounting for 12.9%. The proportion of other elements is less than 10%, and the number of buttons, audio, and video elements is relatively small, with 3.03%, 1.08%, and 0.02%, respectively. Multimedia teaching video technology has greatly improved teaching effectiveness, promoted students' interest in learning, intuitively processed abstract theories and complex spatial structures, stimulated students' interest, and promoted their better understanding and memory of knowledge points.

Advanced image retrieval restricts the content components of images, greatly improving retrieval accuracy. However, it increases computational complexity and significantly reduces retrieval speed. In the future, research still needs to optimize algorithms to improve system efficiency and speed.

DATA AVAILABILITY

The figures and tables used to support the findings of this study are included in the article.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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