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Investigation on Motion Teaching Video Compression Algorithm Based on Artificial Intelligence

Chao Zhou[1,a,*]

[1]*School of Physical Education, Hunan University of Arts and Science, Changde 415000, Hunan, China*

[a]*522892156@qq.com*

[*]*corresponding author*

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Abstract: Sports are a common activity of human beings, and their development levels vary in different fields. With the continuous progress of science and technology and the increasing level of computer technology, many new algorithms have emerged. This article mainly studied the method and implementation principle of Motion Teaching Video Compression (MTVC) based on artificial intelligence, and verified through MATLAB language simulation experiments the problems and improvement measures in the storage, processing, and output result analysis of commonly used data under the applicable parameters of this control strategy. Finally, the functionality of the algorithm model was tested. The test results showed that the compression ratio of the system was above 85%. The video clarity was very high, and the video bitrate was above 720kbps. The video decoding time was within 3 to 5 seconds. This could improve the compression effect of traditional sports teaching videos and enhance students' interest in learning.

1. Introduction

Robustness is a very important characteristic in the research of motion video compression algorithms. It not only affects the data processing process, but also determines its algorithm performance [1-2]. For example, when the number of real-time sequences input is small, it can be considered that the frame image is relatively complete. However, when selecting representative feature values with a large dynamic range or which can well reflect the long amount of information required, it is only selected for compression operations. Therefore, when selecting video content, it is also necessary to consider robustness to improve the quality of compression coding [3-4].

In the traditional MTVC, many algorithms are based on the analysis of image information, such as white noise filtering, inter frame similarity coefficient method, etc. A scholar has proposed a MTVC algorithm based on the combination of neural network training and decision tree in an article [5-6]. This method analyzes the relationship between moving targets and non velocity, acceleration, and other parameters by modeling and processing the data. Scholars have also proposed research on MTVC algorithms based on neural networks. This compression method obtains the training set from the original sample library by training and analyzing the dataset, learns the sample set, and classifies it based on its features. The online word segmentation technology is used to divide the data into different types for storage and retrieval [7-8]. Therefore, this article was based on artificial intelligence to study the compression algorithm for sports teaching videos.

The application of sports teaching videos in the classroom is becoming increasingly common. This article mainly studied mobile micro courses, PPT, and other network learning resource compression methods based on artificial intelligence algorithms. There are problems when annotating commonly used text blocks and symbols in traditional cognitive contexts. By analyzing the relationship between common text box formats and unstructured information databases, a video teaching control strategy is proposed that combines image feature extraction and retrieval technology with motion object detection algorithms to achieve motion object classification, so as to better complete classroom tasks and provide reference for teachers.

2. Exploration of MTVC Algorithm Based on Artificial Intelligence

2.1. Extraction of Key Frames for Motion Posture

With the development of machine learning technology, extracting motion pose keyframes has become a hot research direction in the field of computer vision. Motion pose keyframes refer to specific keyframes that represent the entire motion state during the motion process. For example, during human walking, there are often two keyframes representing a step. Therefore, extracting these key frames is of great significance for applications such as dynamic video classification and human motion analysis. At present, the main methods for extracting motion pose keyframes are based on trajectory analysis, deep learning, and neural network methods [9-10]. Among them, the trajectory analysis based method divides the trajectory into several segments, and the obtained attitude data must meet certain prior conditions. This method requires analyzing the motion trajectory to extract keyframes. These methods have certain limitations, mainly due to their poor recognition performance for different motion patterns. Meanwhile, due to the different length and complexity of time series, this method is also difficult to generalize to any scenario. On the other hand, deep learning methods are more common. Usually, this method uses RNN or CNN networks to map video frames from sequence space to a feature space. By extracting the statistical information of these features, the frame with the highest entropy value is determined. The advantage of this method is that it can handle motion pattern recognition tasks of different types and lengths, and is suitable for videos with any background information [11-12]. Figure 1 shows the process of extracting motion pose keyframes.

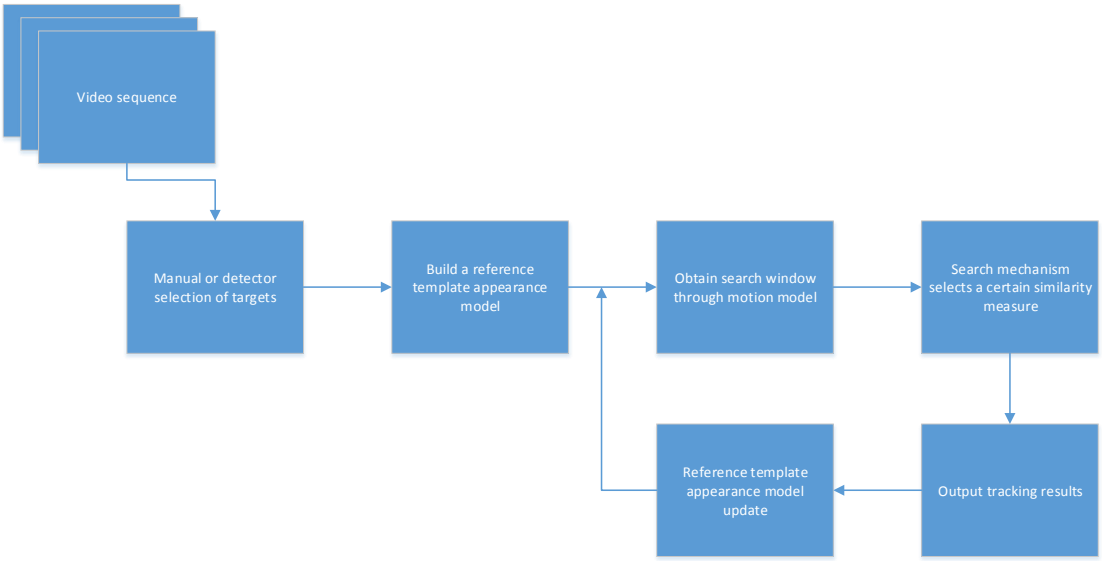

Figure 1. The flow of extracting motion posture key frames

Extracting motion pose keyframes is a very important and complex task, and there are many influencing factors that need to be considered. With the continuous progress of technology, this task may become more efficient and flexible in the future. In this section, the method of extracting keyframes for dynamic motion postures in motion teaching videos is proposed. This keyframe can preserve the original information while reducing data volume, reducing storage costs, and accelerating action replay. During the extraction process, considering the selection of keyframes and the accuracy of extraction, machine learning technology was used to train keyframes to improve their accuracy.

2.2. Key Frame Reconstruction and Application of Frame Insertion Technology

Keyframe is an important concept in computer animation, which refers to the most representative and significant frame among two adjacent frames marked on the timeline. Keyframe technology plays a crucial role in achieving animation effects and optimizing animation performance. With the continuous development of computer graphics technology and the increasing application demand, the reconstruction of key frame technology and the application of frame insertion technology are more and more widely. Firstly, the reconstruction technology of keyframes mainly refers to the reconstruction of a new keyframe sequence by analyzing and processing the original animation sequence, so as to improve the smoothness and realism of the animation [13-14]. This technology can be achieved through a comprehensive approach that involves multiple aspects such as inter frame interpolation; pose optimization, and scene reconstruction. For example, difference calculation and weight allocation can be performed on the original frames to determine the relationship between each frame and generate a new keyframe sequence based on this relationship; visual algorithms such as human occlusion detection can also be applied to change the actions of objects in animation based on the occlusion relationship between objects. In this way, the reconstructed sequence can better reflect the characteristics and details of the animation, and improve the quality of the animation. Secondly, frame insertion technology refers to inserting new keyframes into existing animation sequences to add detail and realism to the animation [15-16]. Figure 2 shows the keyframe feature search process.

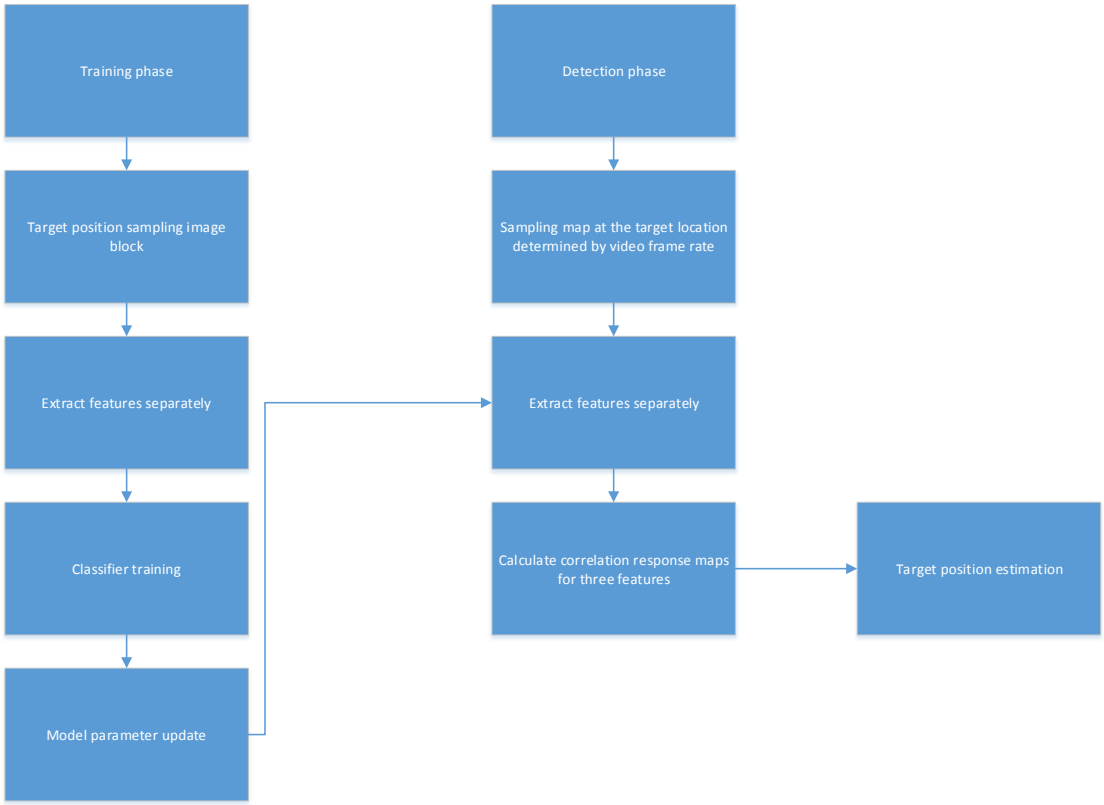

Figure 2. Keyframe feature search process

The technique of inserting frames can be applied to various aspects of animation, including character actions, scene shooting, etc., and can also dynamically generate new keyframes by analyzing and processing the character's body structure, action patterns, motion trajectories, etc. The main problem to be solved in this process is how to use a few keyframes to reflect multiple action states, and how to match the differences between the inserted frame and the original frame. Key frame technology is very important for animation presentation effect and performance optimization, so in the field of modern computer graphics, various new key frame related technologies and algorithms are constantly emerging [17-18]. In this section, how to use the extracted motion pose keyframes to reconstruct the video is discussed. In order to reduce the amount of data, this article proposed an efficient frame insertion technique that could generate small capacity videos without affecting the visual quality of the videos. This technology innovatively determines when to insert keyframes using artificial intelligence algorithms to solve data compression problems.

2.3. Compression Algorithm

Compression algorithm is a technique that can reduce the file size of files or data. Its principle is to reduce the storage space of data by removing redundant information, thereby compressing the data. There are many types of compression algorithms, among which the most common are lossless compression and lossy compression. The main idea of lossless compression algorithms is to utilize various compression algorithms and technologies to reduce redundant information in source data while maintaining the integrity of the source data. This algorithm is usually suitable for application scenarios that require maintaining data integrity, such as compressing file formats such as text, images, audio, etc. Common algorithms include Huffman encoding, LZW (Lempel-Ziv-Welch)

compression algorithm, arithmetic encoding, etc. [19-20]. The lossy compression algorithm achieves data compression by discarding some unnecessary information in the source data. This algorithm is suitable for situations where the integrity of specific information in compressed files is not high, or the source data contains some redundant information, such as the compression of multimedia data files such as images, audio, video, etc. Common lossy compression algorithms include JPEG, MP3, MPEG, etc. Although lossy compression algorithms can achieve higher compression ratios, they may also result in partial information loss of the source data, and there may be some accuracy loss in data restoration after compression. Lossless compression refers to the use of a compression algorithm to compress a file or data into a smaller file while maintaining the integrity and accuracy of the file. This method depends on finding redundant information in a data and deleting it to reduce the size of the file without removing any data from the file itself. In order to obtain a filter that can map the training data to the expected output, the filter template is solved by establishing the minimum output square error and the model. Considering the influence of the appearance transformation of the target, l images of the target are simultaneously considered as reference samples to improve the robustness of the filter template. The objective function obtained from this is as follows:

$$\min \sum_{i=1}^{l} \left| F_i \bullet H^* - G_i \right|^2 \tag{1}$$

Fi is the ith function object representing the objective function. This problem is a convex optimization problem. To minimize the objective function, it only needs to take a partial derivative of the formula and make the partial derivative zero:

$$0 = \frac{\partial}{\partial H^*} \sum_{i=1}^{l} \left| F_i \bullet H^* - G_i \right|^2 \tag{2}$$

The formula is solved to obtain the closed form solution of the final correlation filter template as follows:

$$H^* = \frac{\sum G_i \bullet F_i^*}{\sum F_i \bullet F_i^*} \tag{3}$$

When using compression algorithms to compress files, it is necessary to understand the file type and data structure, as well as use appropriate algorithms and parameters to optimize compression performance and speed. For example, image files have obvious duplicate areas, so Hauffman encoding is almost suitable for all situations of image compression. In short, compression algorithms are a technique that can effectively reduce files or data to a smaller file size. Regardless of the compression method used, it is important to use appropriate algorithms and parameters while maintaining good compression ratio and data integrity. This algorithm considers both data complexity and preserves unique visual effects. At the same time, a comparison was made between the encoding methods for keyframes and non keyframes, and evaluations were made from two aspects: encoding rate and image quality.

3. Experimental Process of MTVC Algorithm Based on Artificial Intelligence

3.1. Model Composition of MTVC Algorithm Based on Artificial Intelligence

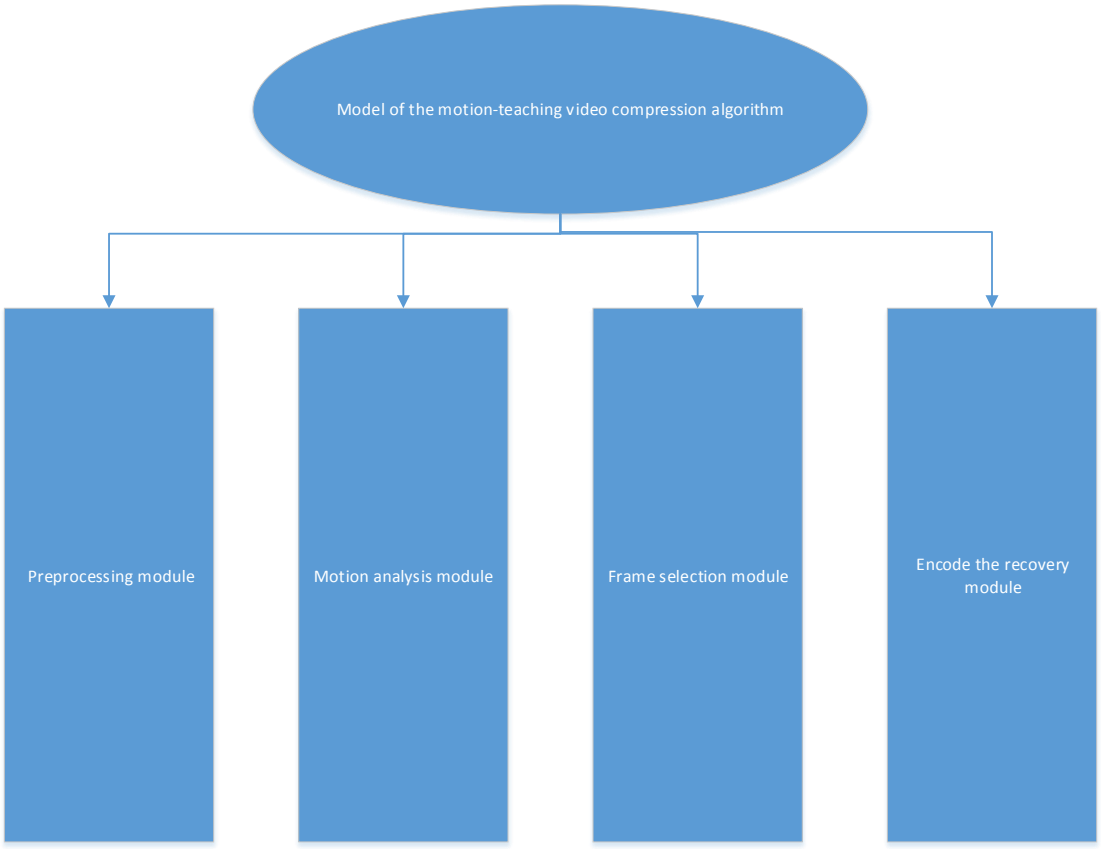

Figure 3. Model composition of MTVC algorithm based on artificial intelligence

In the field of sports teaching, video compression algorithms developed using artificial intelligence technology can effectively optimize and improve teaching quality and efficiency. The MTVC algorithm based on artificial intelligence mainly includes four modules (as shown in Figure 3): preprocessing module, motion analysis module, frame selection module, and encoding restoration module. In the preprocessing module, key information, including image features, is extracted from the video by analyzing and parsing it. After obtaining image features, the motion analysis module can use artificial intelligence technology to perform motion analysis on the image. This module adopts deep learning technology, trains models through machine learning, and combines traditional motion analysis methods to perform efficient motion analysis on videos. In the frame selection module, the key frames in the image would be selected based on the motion analysis results as descriptive frames for the motion process. This module adopts a random decision forest based method for frame selection, ensuring that the selected key frames can reflect more accurate and complete motion process information. Finally, in the encoding restoration module, some efficient encoding restoration algorithms can be used to re encode the selected keyframes to achieve video compression. This module mainly utilizes existing video coding standards and combines artificial intelligence technology to improve the efficiency of video encoding and restoration by learning and optimizing data. In summary, the MTVC algorithm based on artificial intelligence achieves refined and efficient processing of motion teaching videos through the collaborative action of multiple modules. This technology can effectively improve teaching quality

and efficiency, while also having certain commercial value and market prospects. This model has multiple inputs and output layers and is suitable for various types of teaching videos. It maximizes the reduction of video file volume while ensuring the accuracy of motion postures and visual effects.

3.2. Testing of the Function of the MTVC Algorithm Model Based on Artificial Intelligence

With the rapid development of artificial intelligence, sports teaching video resources are becoming increasingly abundant, but these video files often face difficulties in storage and transmission due to their large size. To solve this problem, an algorithm model that can quickly compress motion teaching videos is needed. This article mainly introduced the functional testing process of the MTVC algorithm model based on artificial intelligence. During the testing process, it is necessary to prepare some test datasets that include different types of sports teaching videos, such as yoga, fitness, dance, etc., as well as videos with different resolutions and compression ratios. These datasets are input into the algorithm model to examine the impact of the model on the quality, bit rate, and decoding time of compressed videos. The main indicators are as follows: Firstly, compression ratio: While maintaining video quality, the compression ratio that the model can achieve is one of the key indicators. High compression ratios can lead to video distortion and other issues, thereby affecting the user's visual experience. The second is video clarity: Video clarity is an important indicator for measuring video quality. Has the clarity of the video significantly decreased after compression? If so, what is the degree of reduction? The third is the bit rate: The compressed video bit rate of the model refers to the number of bits transmitted per second in the video. The algorithm of the model should ensure that the video still has a good visual effect even with high or low bit rates. The fourth is decoding time: It refers to the time required for the compressed video to be decoded into the original video. The algorithm of the model should ensure that the decoding time does not increase too much; otherwise it would affect the user experience. Based on the above indicators, this article could conduct functional testing on the model. The test results should include data on model usage, throughput, and performance. In addition, it is also necessary to conduct testing based on practical application scenarios, such as whether the compressed video of the model can effectively improve user click through when promoting sports products on e-commerce platforms. In summary, when conducting functional testing on the MTVC algorithm model based on artificial intelligence, key indicators such as compression ratio, video clarity, bit rate, and decoding time should be paid attention to. At the same time, it is also necessary to conduct testing in conjunction with practical application scenarios in order to better meet user needs.

4. Experimental Evaluation of MTVC Algorithm Based on Artificial Intelligence

Table 1. Performance test of MTVC algorithm

Test times	Compression ratio (%)	Video clarity	Code rate (kbps)
1	87	High	720
2	89	Very high	1080
3	85	High	720
4	86	High	720
5	87	Very high	1080

This article would test and analyze the functionality of the model. This algorithm combines multiple machine learning technologies to optimize the compression processing of motion teaching videos. It not only greatly reduces the size of video files, but also ensures the clarity and

smoothness of the video. Next, this article tested and analyzed the functionality of the MTVC algorithm model based on artificial intelligence. The algorithm model includes the following functions: video preprocessing function. This function optimizes the original video through techniques such as image processing and image enhancement. This can eliminate factors such as horizontal lines and noise in the video, and improve the quality of the video. Secondly, it is the video segmentation function. This function would divide the video content into several keyframes and optimize each frame based on parameters such as the video's motion position and angle. This can reduce the size of the video file and reduce the degree of compression distortion in the video. Thirdly, it is a video encoding function based on deep learning. This function utilizes Convolutional Neural Networks (CNN) to encode and process videos, improving compression rate and video quality. In addition, the encoder also has adaptability and can automatically adjust parameters based on different styles of videos to optimize compression performance. From Table 1, it could be seen that the compression ratio of this algorithm was above 85%, and the video clarity was very high, with a video bitrate of over 720kbps.

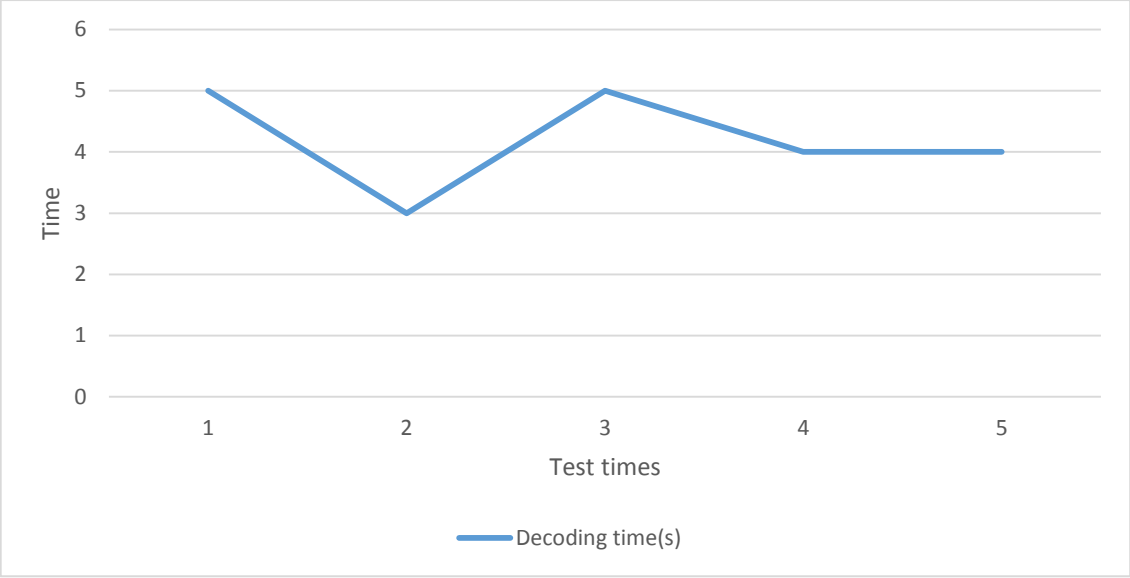

Figure 4. Video decoding time

The algorithm model also includes functions such as face detection and action analysis. These functions can monitor in real-time whether the movements in the video are standard and effective, and allow users to use image recognition technology to better master sports skills and exercise methods. From Figure 4, it could be seen that the video decoding time of the algorithm model was within 3 to 5 seconds. In summary, the MTVC algorithm model based on artificial intelligence had multiple excellent functions. Through testing and analysis, it could be found that these functions were very reliable and stable in practical use. It is believed that the algorithm model would play an important role in the field of sports education, helping more people achieve a healthy lifestyle.

5. Conclusions

Sports are an important strategy for a country's development, and they belong to the crystallization of human wisdom, which is closely related to human life. This article first introduced the basic knowledge of algorithms required for programming based on machine learning algorithms. After analyzing and comparing traditional commonly used compression packages and implementing corresponding improvements based on actual needs, the software was applied to the compression

and playback process of sports teaching videos. The feasibility, effectiveness, and operability of this method were verified through experiments. Through experimental comparison, the impact and mechanism of this method on different types of students were verified, and its compressed data simulation results were compared on the MATLAB platform.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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