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Research on Intelligent Batch Evidence Collection for Video Duration

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Abstract

This paper investigated the intelligent batch evidence collection technology for video duration. With the rapid growth of digital video content, accurately obtained and analyzed video duration has become a significant challenge. Fields such as judiciary, copyright protection, and advertising monitoring urgently require efficient and accurate batch video duration collection procedures. This paper discussed key technical points of intelligent batch extraction of video duration, including common video formats, intelligent analysis technologies, and applications of big data analysis techniques. It implemented automatic identification of video formats through file extension analysis and file header detection and designed a module for extracting video duration. Additionally, video content analysis algorithms were optimized to enhance processing speed and accuracy. During the data preprocessing phase, video duration data was cleaned, organized, deduplicated, and supplemented for missing values, constructing a high-quality video duration dataset. By employing statistical analysis and data mining methods, the paper delved into video duration data and provided detailed data support for case handling. The results were visualized to offer intuitive support for decision-making. The research findings were summarized, with existing problems and directions for improvement pointed out, along with suggestions for future research, including continuous optimization of algorithms, models, or system architectures, and the introduction of cloud computing and big data technologies to build efficient and scalable video evidence collection platforms, as well as exploring cross-platform video processing and analysis solutions and more applications of intelligent technologies.

Keywords

Intelligent; Batch Evidence Collection; Video Duration

1. Introduction

In recent years, with the rapid growth and dissemination of digital video content, the accurate acquisition and analysis of video duration has become a significant challenge in the field of information technology [1-3]. In many areas, such as the judiciary, copyright protection, and advertising monitoring, accurately and efficiently collecting and analyzing video duration is crucial [4]. However, as the number of videos continues to increase, traditional manual methods can no longer meet the demands for processing and analyzing large-scale video duration data. Therefore, there is an urgent need for an efficient and accurate batch video duration collection program to meet the requirements across various fields.

In the judiciary, videos are an important piece of evidence, and the accuracy of their duration is critical for case review and judgment. However, traditional evidence-collection methods often rely on manual measurement and recording, which are not only inefficient but also prone to errors, making it difficult to handle large volumes of video data effectively. Thus, there is an urgent need for a reliable batch video duration collection program to help legal institutions process and analyze video duration data more effectively, improving the accuracy and efficiency of judicial evidence collection.

At the same time, with the rise of online video platforms and the widespread dissemination of digital video content, the accuracy and credibility of video duration are particularly important for evidence collection. In terms of copyright protection, it is necessary to ensure accurate recording and analysis of video duration to assess related infringement actions [5]. For advertising monitoring, correctly calculating video duration helps advertisers and platforms accurately evaluate ad playtime, ensuring the effectiveness and fairness of ad placements. Traditional evidence-collection methods are often time-consuming and labor-intensive, and they are also prone to errors, making them inadequate for processing large-scale video data. Therefore, there is a pressing need for a reliable batch video duration collection program to assist relevant institutions in managing and analyzing video duration data more effectively, protecting legal rights, and promoting healthy industry development.

2. Video Duration Intelligent Bulk Extraction Key Points

2.1 Common Video Formats

In video forensics, there are often various video formats, as shown in Table 1 [6]. These formats have different characteristics and uses, making it crucial to identify and process them to ensure the program's universality and accuracy. By supporting multiple video formats, the program can adapt to video files from different sources and uses, enhancing the efficiency and flexibility of forensic work.

Table 1. Common Formats in Video Forensics

.MP4	A widely used video format that supports high-quality video and audio compression, offering good compatibility and small file sizes, making it suitable for online transmission and storage.
.AVI	An older video format that supports lossless compression, suitable for preserving high-quality video data, but with relatively large file sizes.
.MOV	Developed by Apple, typically used for storing QuickTime format videos, supporting various encoding formats, and commonly used on Mac systems.
.FLV	A streaming media format particularly suited for transmitting video content over the internet, with smaller file sizes and fast loading times, though it may lose some quality when compressed.
.WMV	Developed by Microsoft, usually played in Windows Media Player, supporting various resolutions and bit rates, making it suitable for streaming playback over different network bandwidths.
.GIF	Although primarily an image format, it can also store short animations or video clips. It has a small file size but limited color quantity and resolution.
.WebM	While mainly an image format, it can also store short animations or video clips. It has a small file size but limited color quantity and resolution.

2.2 Intelligent Analysis Technology

In the field of video processing, intelligent analysis technologies such as image recognition and video content analysis play crucial roles. Image recognition technology can automatically identify key information from videos, such as faces, license plates, and objects, enabling real-time monitoring and tracking of specific targets, enhancing security surveillance efficiency, and improving the accuracy of video forensics. It also allows for the classification and tagging of video content, facilitating subsequent retrieval and analysis [7]. Video content analysis technology provides in-depth analysis of scenes and behaviors within videos. In smart security applications, it can detect abnormal behaviors, such as intrusions or fights, and issue timely alerts. This aids in quickly extracting and analyzing key clues from videos, offering functionalities like content summarization, advertisement monitoring, and copyright protection, resulting in richer and more diverse video processing capabilities.

Intelligent technologies like image recognition and video content analysis can integrate to achieve comprehensive analysis and understanding of video content. Through machine learning algorithms, these technologies continuously optimize and enhance the accuracy and efficiency of video processing. In practical applications, intelligent technologies can also combine with other technologies, such as big data, providing more comprehensive and efficient support for video processing, thereby offering strong assistance in case handling. The application of these intelligent technologies significantly boosts the capability and efficiency of video processing.

2.3 Big Data Analysis Technologies

Big data analysis technologies use algorithms to enable computers to learn and improve automatically, achieving tasks such as data classification, prediction, and clustering. Machine learning methods include decision trees, neural networks, and support vector machines, which are widely applied in fields like image recognition, visual recognition, and video forensics [8]. Big data analysis relies on vast data sets sourced from various channels, including but not limited to surveillance systems and online video platforms. Big data encompasses various types of data, such as structured, semi-structured, and unstructured data. In video duration data analysis, in addition to structured data on video duration, it may also involve unstructured data such as metadata and tags related to video content. Big data analysis emphasizes the rapid processing and analysis of data to meet the demands of real-time decision-making. In video duration data analysis, this means being able to quickly extract, process, and present video duration information, providing timely support for case handling.

3. Automatic Video Format Recognition

3.1 Research on Format Recognition Algorithms

File format recognition can be achieved through file extension analysis, which is a method of determining video format based on the suffix of the video file name. For example, by identifying suffixes like ".mp4" or ".avi" in the file name, one can initially determine the video file format. File extension analysis is simple and quick; however, in some cases, files may be renamed or disguised, causing the extension to not accurately reflect the true format of the video.

Further, there is file header detection, which determines video format by analyzing specific byte sequences at the beginning of the video file. Each video format has its unique file header identifier. Compared to file extension analysis, file header detection is more reliable, as it does not depend on the file name suffix but instead is based on the actual characteristics of the file content. File header detection requires a certain level of technical foundation and algorithmic support, but it can achieve accurate recognition of video formats, especially when handling renamed or disguised video files [9].

3.2 System Implementation

To process video files of different formats, the program needs to automatically recognize the format of the video files, which is essential for smoothly executing subsequent operations (such as calculating video duration). The program traverses the directory selected by the user to obtain a list of all files within that directory. For each file, the program checks its suffix (such as .mp4, .avi, .mov, etc.), which are typically associated with specific video formats. By matching against a list of known video format suffixes, the program can identify the format of each file.

Since this functionality primarily relies on matching file suffixes, it can quickly recognize the formats of a large number of video files. As long as the file suffix is correct and conforms to common video format specifications, the accuracy of recognition is generally high. The program maintains a list of various video format suffixes to support the processing of multiple common video formats. However, when dealing with vast amounts of video data, it is inevitable to encounter some corrupted files or unsupported formats. To enhance the robustness of the program, an error-handling mechanism has been integrated into the design. When an unprocessable video file is encountered, the program skips that file and continues with the next one, while also logging the error information in the operation records for user reference later.

4. Massive Video Intelligent Analysis

4.1 Optimization of Intelligent Analysis Algorithms

The design adopts a modular programming approach, dividing different functions into separate modules. This design creates a clear program structure, making it easier to maintain and expand. When handling massive video data, each module can independently execute its specific tasks, such as video duration calculation and format recognition, thereby improving overall processing efficiency. To accelerate the video processing, multithreading and parallel computing techniques have been employed. By concurrently executing multiple threads, the program can process multiple video files simultaneously, significantly increasing processing speed. Specifically, for calculating video duration, a thread pool is used to manage threads, enabling parallel computation of durations for multiple videos.

4.2 Efficient Video Processing Library

The design utilizes the moviepy library for processing video files. Moviepy is a Python library for video editing that provides rich video processing features, such as clipping, merging, and format conversion. By using the moviepy library, the program can easily obtain video duration information without manual calculations [10]. During batch video processing, the program implements concurrent handling of multiple video files through multithreading. Additionally, by employing synchronous display technology, it can show the processing progress and duration information of each video in real time, allowing users to intuitively understand the program's operational status.

5. Video Duration Big Data Analysis

5.1 Data Preprocessing

To address potential duplicate data in the extracted video duration dataset, we will compare and analyze the entries to merge or delete duplicates, avoiding redundant information in subsequent analyses and ensuring the accuracy and validity of the results. Any missing values in the data should also be filled appropriately. Missing values can negatively impact analysis outcomes, so suitable imputation methods, such as interpolation or regression prediction, should be employed based on the actual data conditions and distribution characteristics, restoring the data's true nature to provide a complete foundation for later analysis.

Through formatting and standardizing the video duration data, we ensure consistency and comparability. By cleaning and organizing the data, a high-quality video duration dataset is constructed, providing a reliable basis for further analysis. The importance of this data foundation is clear; it not only supports statistical analysis and data mining methods but also provides law enforcement with precise and reliable duration data during case handling. Additionally, an in-depth analysis of the video duration data reveals key metrics such as distribution, average duration, and total duration, offering robust data support for police decision-making.

5.2 Data Analysis Methods

Statistical analysis and data mining methods can be used for a comprehensive and in-depth examination of the video duration data. The analysis process includes calculating basic metrics such as average duration and total duration, along with more complex statistical measures like standard deviation and median to fully assess the distribution of video durations. Furthermore, leveraging data mining techniques, we can explore potential relationships between video duration and factors like video type, source, and filming time, further analyzing the distribution patterns and characteristics of video durations across different dimensions.

These in-depth analyses provide detailed data support regarding video duration for investigating officers, helping them better understand the potential links between video duration and cases. For instance, certain types of cases may exhibit longer average video durations, while others may show shorter durations; these patterns can offer valuable insights for case investigation and adjudication.

5.3 Presentation of Analysis Results

Building on the thorough analysis of video duration data, we utilize visual aids like charts and graphs to present key information such as distribution and trends in an intuitive and clear manner. Carefully designed bar charts, line graphs, and pie charts effectively illustrate the analysis results, allowing law enforcement to easily observe the duration distributions of different video formats or sources. This helps them identify which types of videos are more likely to contain crucial evidence, guiding future evidence-collection efforts. These visual results enhance the readability and comprehensibility of the data, providing a more comprehensive and profound perspective for officers to examine video duration data, and enabling them to make more accurate and scientific decisions.

After evidence collection is completed, the program can generate a report file that includes an operational record of the entire evidence collection process. This report contains information such as the directory of evidence collected, the duration of each video file, the total duration, and the report generation time. This reporting feature makes the evidence collection results more intuitive and understandable, while timestamps create a traceable record for use as case evidence.

6. Conclusion and Prospects

As video formats continue to update and evolve, systems need to continuously update their format recognition libraries and preprocessing algorithms to adapt to these changes. Optimization of algorithms for analyzing massive video data also requires ongoing efforts to improve system performance and accuracy. It is worthwhile to explore how to integrate technologies such as cloud computing and big data to build a more efficient and scalable video forensics platform. By leveraging the distributed computing capabilities of cloud computing and the storage and analytical power of big data, we can achieve rapid processing and analysis of vast amounts of video data, thereby enhancing the efficiency and accuracy of video forensics.

In the future, further exploration of cross-platform video processing and analysis solutions could be pursued to achieve compatibility and interoperability across different operating systems and hardware environments. This would help expand the system's application range and increase its practical value. With the continuous advancement of artificial intelligence technology, we can further introduce intelligent and automated methods to optimize video processing and analysis workflows. By utilizing technologies like deep learning for automatic recognition and classification of video content, we can enhance the accuracy and efficiency of analyses. The introduction of more advanced deep learning models could further improve the ability to recognize complex scenes and behaviors, reducing false positives and missed detections.

Additionally, it would be valuable to explore the application of more intelligent technologies in video forensics, such as natural language processing and sentiment analysis, to achieve a more comprehensive and in-depth understanding and analysis of video content. This would aid in extracting key information from videos from multiple perspectives, providing more thorough and robust support for case handling.

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