A Preliminary Study on Content Mining and Visualization of All-Media Content Repository Postprints

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Abstract

With the construction of omnimedia content repositories, the quantity of resources within these repositories has exhibited exponential growth. The emergence of massive information volumes has left users feeling overwhelmed and disoriented, making it difficult to locate truly needed content resources—giving rise to the so-called "information overload" phenomenon in the Internet industry. To enable users to more easily utilize and comprehend the diverse and voluminous media resources within content repositories, and to better advance the specialization and personalization of omnimedia content services, this paper analyzes emerging requirements in content management, content services, and content value mining for contemporary omnimedia repositories, describes applicable analytical and mining technologies for various media types, and ultimately presents repository content intuitively to users through information visualization techniques, thereby facilitating enhanced user understanding and utilization of omnimedia content.

Full Text

A Brief Discussion on Content Mining and Visualization in All-Media Content Libraries

Abstract: With the construction of all-media content libraries, the volume of resources is growing exponentially. The resulting information overload makes users feel overwhelmed and unable to locate truly needed content resources—a phenomenon known as "information overload" in the internet industry. To help users more easily utilize and comprehend the diverse and massive media resources in content libraries, and to better promote distinctive and personalized all-media content services, this paper analyzes emerging requirements in content management, content services, and value extraction for current all-media

content libraries. It describes available analysis and mining technologies for various media types, and ultimately presents all-media content intuitively to users through information visualization techniques, enabling easier understanding and utilization of all-media content.

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1. New Demands for All-Media Content Services

All-media content libraries constitute a critical component of converged media platforms, enabling cross-media content resource management and integrating all online all-media content resources across the organization. By constructing such libraries, organizations can achieve unified retrieval, sharing, and rapid invocation of content, truly activating existing media assets and media content resources within various business systems. This provides content support for all-media converged production, command planning, and content operations. Currently, broadcast converged media platform construction is in full swing, and under new technological platforms and business architectures, the objects, processes, and service methods of media content management have consequently evolved.

Users require richer content discovery methods beyond simple category browsing and full-text search. When users have clear search intentions, they must be able to obtain accurate content anytime and anywhere through various search methods. When users lack explicit goals, the system should achieve a “read your mind” level of response, transforming service delivery from passive to active and combining content with user needs to provide precise, relevant content analysis services.

Original content re-creation represents the core competitive advantage of traditional media in terms of content [1]. All-media content libraries must provide users with more content visualization analysis tools, enabling multi-dimensional understanding of content through visualization. This makes content analysis and mining simpler, more intuitive, and more user-friendly, allowing users to conduct interactive, visual content exploration.

2. Research and Application of Content Visualization Technology

Supported by advanced technologies such as big data and artificial intelligence, all-media content libraries innovate media content services. Through tag extraction from all-media content and deep analysis and computation based on these tags, content mining is achieved—including indexing, keyword extraction, automatic summarization, classification, clustering, sentiment analysis, and correlation calculation—followed by interpretation and representation of the results. Ultimately, content visualization provides users with more friendly and accurate content services.

2.1 Feature Extraction and Computation for All-Media Content

All-media content libraries encompass text, images, audio, and video. All-media content contains multi-dimensional descriptive features, and extracting these features forms the foundation for analyzing and mining all-media content.

2.1.1 Text Feature Extraction Through natural language processing technology, all-media content libraries analyze text content—including part-of-speech analysis, keyword extraction, automatic summarization, and sentiment analysis—to extract relevant text features.

2.1.2 Image Feature Extraction Through AI image technology, images in the content library are automatically converted into textual descriptions covering scene descriptions, object classification, people, landmarks, hot terms, and more. This extracts semantic feature information from images across different dimensions and levels [2]. After extracting relevant feature vectors, a multi-dimensional feature vector representing the image is formed. Through vector computation, the distance or similarity relationships between image feature vectors in the feature vector space are compared and analyzed to complete correlation analysis of image content, enabling the system to achieve high-level image understanding.

2.1.3 Video Feature Extraction Through AI video processing technology, videos in the content library are intelligently analyzed across multiple dimensions, including speech, text, faces, objects, and scenes within the video, to extract feature information describing video content. Features include video classification, people, speech-to-text, objects, subtitles, titles, and bullet comment text content.

2.1.4 Audio Feature Extraction Through AI technology, audio in the content library is intelligently analyzed. Audio mining typically employs two methods: converting speech in audio to text for feature extraction, or extracting musical features such as pitch and melody, as well as speaker voiceprint features

to identify people. The extracted audio features enable correlation analysis and computation of audio content.

2.2 Tag-Based Content Analysis

1. **Content Distribution Analysis Tools:** Through content attributes and tags, users can independently conduct content analysis and statistics using various visualization components, enabling the most intuitive understanding of content library composition.
2. **Hot Content Mining Tools:** Visualization tools allow intuitive discovery of current hot topics, with drill-down capabilities to analyze and mine content related to these hotspots. Users can select different domains—including current affairs, economics, sports, people's livelihood, film and television—to focus more specifically on hot content mining.
3. **Intelligent Topic Generation:** Through intelligent mining and correlation of massive content, event topics, people topics, and custom topics are automatically aggregated and generated. By visually presenting content clustering analysis results, these tools help users mine potential content and provide intelligent support for topic decision-making, content production.
4. **Word Cloud Analysis Tools:** Based on tag data from selected content ranges, word clouds display tag data intuitively, showing business personnel public opinion keywords, news keywords, comment keywords, and more.
5. **Sentiment Analysis Tools:** Through intelligent analysis of comments and public opinion content using advanced deep learning technology, precise content mining is achieved. Sentiment analysis performs positive/negative judgment tailored to media domain characteristics, extracting high-value information relevant to users [4].

2.3 Visualization Applications for Multiple Media Types

For content visualization in all-media content libraries, data types cover text, multi-dimensional data, audio/video, and spatio-temporal data. Display methods include standard 2D/3D charts, image rendering, list displays, and map displays.

Multi-dimensional data visualization analysis aims to discover distribution patterns and logical relationships between dimensions, typically using curves, line charts, scatter plots, pie charts, bar charts, radar charts, heatmaps, and other charting methods.

For text content visualization, tag clouds are commonly used [3]. This technique directly extracts keywords from text and presents them on screen in an orderly and aesthetically pleasing manner. Since keywords have varying distribution

frequencies and importance levels in text, font size and color intensity can reflect these differences—more important, high-frequency keywords use larger, more prominent fonts.

2.4 Exploratory Visualization Content Analysis

Visual self-service content exploration tools assist users in analyzing and mining content through visualization, producing valuable insights for content production. The entire "visualized" content mining process can be completed by users through simple drag-and-drop and interactive operations, with multiple display forms and second-level response times. This enables users to discover potential correlations behind content in the most intuitive way possible.

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3. Core Modules for All-Media Content Library Construction

All-media content libraries aim to create an intelligent content management engine with large capacity, multiple types, learning capabilities, and interactivity. Through the all-media content service platform, massive content from multiple channels can be fully absorbed. After content organization, precise querying, correlation retrieval, and visual analysis can be achieved.

Tags represent the features of media content described above. Through tags, content is described and represented, including any content in the all-media content library such as internet aggregation, communication manuscripts, story proposals, topics, and reports. Compared with traditional "classification" concepts where content belongs to only a few fixed categories, content can have many tags across different dimensions. While classification definitions are relatively fixed and limited in number, tags can be expanded without limit, added freely, and have timeliness. The content explosion in all-media content libraries creates opportunities for tags, enabling multi-dimensional management of massive content.

Tag-based content analysis allows systems and users to understand content more deeply and across more dimensions. By extracting expressive and salient features from all-media content, tags describing the content are formed.

Tags address users' "discovery" needs for massive all-media content. In content libraries with massive all-media resources, tags provide the most convenient and reliable method for users to quickly and easily find needed content. For users, tags effectively organize, structure, and manage content.

Tags help users mine content value in all-media content libraries. AI technology mines content tags across different dimensions, making exploratory content mining possible for users. Users can observe content from different angles through visualization, discovering deeper content value.

3.1 Content Processing Engine

For different types and sources of content, the processing engine automates content structuring. Capabilities include:

- **Content Filtering:** Analyzes content metadata, text information, and system configuration to set importance and confidentiality levels.
- **Content Screening:** Filters duplicate content, spam, and advertisements. For audio/video materials, it prevents duplicate uploads from being entered into the database repeatedly.
- **Content Review:** Based on sensitive word and feature libraries, filters and detects text, images, and videos. Automatically filters sensitive content from aggregated materials and places them in a pending area for manual secondary processing.
- **Subtitle Detection and Recognition:** Detects whether subtitles exist in videos and converts subtitles to text.
- **Face Detection:** Detects whether specific people's faces appear in content.
- **Video Tag Extraction:** Identifies scenes, people, landscapes, buildings, and daily objects in videos, supporting multi-level image semantic information extraction to enrich content tags.
- **Multi-format Conversion:** Converts various audio, video, image, and text materials into standard production formats and bit rates for TV news production networks or new media use.

3.2 Content Mining Engine

Through AI technology, the engine mines attributes, text, and tags of massive content in the database, including classification, clustering, automatic correlation, entity name extraction, sentiment analysis, and tag extraction [1].

- **Classification:** Automatically classifies incoming content by analyzing metadata, text information, content tags, and classification configuration.
- **Clustering:** Based on cataloging information and automatically extracted tags, supports automatic classification by file attributes, metadata analysis, automatic metadata correlation, and topic similarity clustering. Automatic clustering technology can focus on online hot topics within a time period, with customizable sources and categories for clustering operations.
- **Automatic Correlation:** Automatically correlates related news manuscripts and similar multimedia materials to form news material collections, facilitating targeted selection by editors. Customizable sources and flexible configuration of correlation analysis sensitivity are supported.
- **Entity Name Extraction:** Extracts domain-specific entity names including program names, episode names, starring actors, hosts, and directors.

- **Sentiment Analysis:** Performs sentiment analysis on public opinion and comments.
- **Tag Extraction:** Automatically extracts keywords from content metadata and text to form content tags.

3.3 Visualization Rendering Engine

Through flexible use of HTML5 technology, the engine adapts to different display modes. Combined with CSS3 animation features and the characteristics of media content itself, it presents patterns and connections hidden within massive media content in more vivid and user-friendly forms in real time.

All-media-based media convergence business no longer focuses solely on materials and programs as the core of content preservation and usage, nor relies primarily on manual cataloging and structured data preservation. Instead, it extends to all-media business operations, covering multiple content forms including materials, programs, TV manuscripts, WeChat/Weibo content, and H5 pages. Content cataloging emphasizes automated data extraction, intelligent cataloging, and preservation of unstructured raw data, with continuous mining of original content data valued [5]. Additionally, through data mining of proprietary content, thematic event databases and knowledge bases can be automatically formed through modeling to support business decision-making, production, and distribution. Core modules include the aforementioned content processing engine, content mining engine, and visualization rendering engine.

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Note: Figure translations are in progress. See original paper for figures.