

Research Article

Visual Analytics Techniques for Large Scale Multimedia Datasets: Interactive Visualization and Decision Support in Creative Industries and Big Data Applications

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Abstract: This study explores the role of visual analytics in enhancing decision-making processes within creative industries, focusing on its application to large-scale multimedia datasets. Visual analytics integrates interactive visualization techniques with computational algorithms, enabling users to explore complex datasets intuitively and derive actionable insights. The research centers on the design and implementation of interactive dashboards tailored to the creative sector, particularly film, music, and advertising industries, to facilitate real-time data exploration. The study also investigates the usability of these tools through expert-based evaluations, aiming to assess their effectiveness in supporting informed and timely decision-making. The findings reveal that interactive visualizations significantly improve insight discovery and pattern recognition, enabling decision-makers to uncover hidden trends in large multimedia datasets. However, challenges related to scalability, user acceptance, and real-time processing were encountered during the implementation phase. The research highlights the practical benefits of integrating visual analytics into industry workflows, which include enhanced content creation, audience engagement, and strategic planning. Furthermore, the study identifies key visual analytics techniques such as dynamic dashboards, pattern recognition, data mining, and clustering, which are essential for analyzing multimedia data. The study concludes by emphasizing the potential for wider applications of visual analytics in other sectors, suggesting future research directions to improve tool performance, scalability, and user accessibility, as well as exploring the integration of emerging technologies like artificial intelligence and virtual reality.

Keywords: Visual analytics; Decision-making; Multimedia datasets; Creative industries; Data visualization.

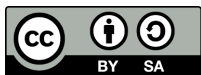
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1. Introduction

The creative industries, encompassing sectors such as music, animation, film, and digital games, are increasingly reliant on large-scale multimedia datasets to fuel innovation and maintain a competitive edge. As these industries embrace Fourth Industrial Revolution technologies like artificial intelligence (AI), cloud computing, big data, and blockchain, they are presented with both opportunities and challenges in utilizing these datasets effectively [1]. However, despite the potential of these technologies, extracting actionable insights from vast multimedia datasets remains a complex task, requiring advanced techniques and strategies.

The rapid advancement of multimedia processing tools has opened new doors for creative industries to leverage datasets like the Yahoo-Flickr Creative Commons 100 Million (YFCC100M) to push the boundaries of multimedia analysis, search, and visualization [2]. These large-scale datasets present unique opportunities to innovate, but also require the development of novel methods and algorithms for processing and analyzing them. By employing these methods, industries can gain deeper insights into their content, improving multimedia understanding and decision-making [3].

Despite these advancements, several challenges persist in the extraction of meaningful insights from multimedia data. The sheer complexity and volume of big data pose significant obstacles, as organizations struggle to process and interpret the rapidly arriving data streams [4]. Additionally, issues such as noise, label noise, and domain mismatches in automatically collected datasets further hinder the accuracy of analysis [5]. Furthermore, there remains a significant semantic disparity between low-level features and high-level concepts, complicating the creation of efficient multimedia retrieval systems [6]. In addition to these technical challenges, the handling of sensitive information poses data security and privacy risks that must be carefully managed [1].

To overcome these challenges, the application of advanced analytical techniques is essential. Approaches such as statistical analysis, machine learning algorithms, and text mining can help extract valuable insights from large-scale multimedia datasets [4]. Additionally, innovations in situation recognition, which involve deriving actionable insights from heterogeneous, real-time multimedia data, are helping to address real-world challenges in sectors like healthcare, disaster management, and economic decision-making [6]. By integrating multimodal semantic fusion, explainable AI, privacy-preserving learning, and continual adaptation, creative industries can build robust multimedia retrieval systems that are both versatile and trustworthy [3].

Visual analytics is a multidisciplinary field that integrates interactive visualization interfaces with automated techniques to support human decision-making and knowledge discovery, particularly in the context of large-scale datasets. As the volume and complexity of data continue to grow across various industries, including the creative sectors, effective tools are required to transform raw data into actionable insights. The primary goal of visual analytics is to create interactive and scalable environments that enable users to explore and make decisions based on data [7]. Techniques such as dynamic dashboards, immersive 3D representations, and scalable visual query methods have been developed to facilitate this process [8].

Advanced visual analytics tools play a critical role in enhancing the understanding and insight generation from complex datasets. By leveraging both human cognitive capabilities and machine processing power, these tools enable the quick, intuitive, and interactive analysis of large datasets [9]. This capability is particularly important in fields such as multimedia analytics, where integrating human expertise with automated processing is essential for generating valuable insights [10]. These tools enable real-time decision-making by providing dynamic dashboards and immersive 3D visualizations that support spatial understanding, uncover hidden patterns, and inform strategic decisions [11].

The scalability and interactivity of visual analytics systems are fundamental to managing large-scale data efficiently. These systems use techniques like incremental visual analysis and spatiotemporal clustering to maintain responsiveness while handling large datasets [12]. By doing so, they ensure that decision-makers can interact with and explore data without being overwhelmed by its volume. Furthermore, visual analytics tools are particularly effective in supporting the analysis of complex, multidimensional data, combining creativity, human knowledge, and computational power to deepen understanding and inform decisions [9].

Visual analytics also drives innovation and progress by integrating advanced analytics, machine learning algorithms, and predictive modeling. These integrations enable organizations to conduct scenario analysis, risk assessments, and strategic planning more effectively [7]. As such, visual analytics is not only enhancing decision-making capabilities but also fostering innovation across a variety of sectors, from finance and healthcare to education and beyond [13].

2. Literature Review

Current Trends in Creative Industries: Overview of Multimedia Datasets Usage

Multimedia datasets have become increasingly integral to various creative industries such as film, music, and advertising. These industries are undergoing a significant transformation due to the integration of digital technologies, including artificial intelligence (AI), cloud computing, and big data analytics [14]. These technologies enable the efficient collection and processing of vast amounts of multimedia data, which plays a crucial role in shaping creative content and strategic decision-making. For instance, platforms like Netflix and Spotify utilize consumer data to personalize content and predict trends based on user preferences and

consumption behaviors [14]. This data-driven creativity enables content creators to tailor productions, improve audience engagement, and make informed decisions about content offerings [15].

In the music industry, the growing use of multimedia datasets, including listening patterns and user interactions, has revolutionized how releases are planned, targeted, and promoted. The ability to track and analyze consumer behavior allows music organizations to optimize their marketing strategies and release schedules [15]. Similarly, in the advertising industry, multimedia datasets are used to craft targeted campaigns that resonate with specific consumer segments. By analyzing various data points such as viewer demographics, engagement patterns, and purchasing behaviors, advertisers can deliver more personalized and effective messages [3]. Overall, the use of multimedia datasets is driven by the increasing demand for innovation in content creation and a deeper understanding of audience behavior, which is critical for economic growth and cultural impact in creative sectors [16].

Challenges with Traditional Analytics: Limitations of Traditional Data Analysis Methods

Despite the growing reliance on multimedia datasets, traditional data analysis methods face several significant challenges in handling large-scale, complex multimedia data. One of the primary limitations is the sheer volume, velocity, and variety of data that traditional systems struggle to process [17]. Traditional methods were not designed to handle the massive and diverse datasets generated by multimedia content such as images, videos, and audio, which are frequently integrated from multiple sources and formats.

Scalability is another critical issue. Traditional machine learning algorithms often struggle to scale when processing millions or billions of data points with multiple dimensions [18]. These systems are not well-equipped to manage the high dimensionality and enormous volume of data typical in multimedia datasets. As a result, there is a need for more advanced computational techniques, such as parallel processing and distributed computing, to handle these large-scale datasets effectively [19].

Another challenge is the semantic disparity in multimedia data. Traditional methods often fail to bridge the gap between low-level features such as raw data (*pixels, sound waves*) and high-level semantics (*themes, emotions, or concepts*), making it difficult to derive meaningful insights [5]. This disparity limits the performance of multimedia retrieval systems and hampers the ability of traditional analytics to accurately interpret and classify multimedia content.

Finally, privacy and security concerns arise when integrating data from various sources. Traditional anonymization techniques may not be sufficient to protect sensitive information, especially in the context of large-scale, diverse multimedia datasets [16]. Ensuring that data is properly anonymized and securely handled is crucial for maintaining trust and compliance with privacy regulations.

Visual Analytics in Big Data: Examination of Previous Research and Applications

Visual analytics has become an essential tool for data exploration and decision support in the context of big data. This multidisciplinary field integrates interactive visualization with computational techniques to help users uncover patterns, trends, and insights from large, complex datasets. Previous research has highlighted the significant role visual analytics plays in transforming raw data into actionable insights, particularly in contexts where traditional data analysis methods are insufficient [7]. Visual analytics facilitates the interaction between human cognitive capabilities and machine processing power, enhancing decision-making across various sectors such as business, healthcare, urban planning, and education [20]. In particular, visual analytics has been applied to support smart decision-making by enabling users to interactively explore big data, which is essential for addressing the challenges posed by the volume, velocity, and variety of data in modern applications [21].

In the healthcare industry, for example, visual analytics has been used to analyze large-scale patient data, helping medical professionals identify patterns in disease progression, treatment effectiveness, and patient outcomes [22]. Similarly, in business and finance, visual analytics tools are used to monitor financial trends, predict market movements, and optimize investment strategies. These applications demonstrate how visual analytics can be used to gain insights from vast, unstructured data and improve decision-making processes, providing a valuable alternative to traditional analysis methods [23].

Furthermore, the integration of visual analytics with deep learning and AI techniques has opened new possibilities for more effective data analysis. For example, visual analytics systems can automatically detect trends and outliers in large datasets, which helps users make timely decisions in industries such as retail, where customer behavior data is continuously generated [24]. This combination of human intuition and machine intelligence allows for faster insight discovery, particularly in applications where the speed of data generation and the need for real-time analysis are critical.

Key Visual Analytics Techniques: Review of Major Techniques Applied to Multimedia Datasets

Visual analytics techniques are essential in handling multimedia datasets, enabling interactive exploration and analysis of large, complex data volumes. One of the most common tools used in this process is interactive dashboards, such as Tableau and Power BI, which allow users to create dynamic, real-time visualizations. These dashboards provide various interactive elements like filters and drill-downs, helping users explore and understand complex data by visualizing key metrics, tracking trends, and interacting with data intuitively [25]. In industries like film and media, these tools enable data-driven decisions by allowing producers to visualize audience engagement metrics across different content types, shaping content strategy and improving viewer satisfaction [26]. Pattern recognition also plays a critical role in multimedia data analysis, where machine learning algorithms, including deep learning models, are used to detect patterns in large datasets. These techniques are particularly valuable for tasks like image and video analysis, where the recognition of complex patterns such as facial expressions, movement, or sentiment can provide valuable insights, enhancing the ability to make predictions or classifications [24].

Another significant visual analytics technique is data mining, which integrates statistical and computational methods with visualization to uncover hidden relationships and insights in large datasets. In multimedia applications, data mining helps identify correlations, detect anomalies, and predict future trends, providing users with the ability to make more informed decisions [27]. For example, in the advertising industry, data mining techniques are employed to analyze consumer preferences and behaviors, enabling marketers to design targeted campaigns. Similarly, clustering algorithms group similar data points into meaningful segments, making it easier for users to explore and analyze multimedia datasets. In the music industry, clustering can categorize songs by genre, tempo, or mood, enhancing recommendation systems that suggest content based on user preferences [22], [28]. These techniques collectively improve decision-making by making complex multimedia data more comprehensible and actionable for users across various industries.

Multimedia Data Transformation in the Big Data Era

The rapid growth of digital technology has significantly increased the volume of multimedia data, including images, videos, audio, and other forms of digital content generated by both human activities and automated systems. These multimedia datasets have become valuable information sources for various sectors such as creative industries, digital governance, and technology-driven business environments. Digital transformation has created a strong demand for analytical methods capable of processing large-scale data efficiently while generating insights that can support strategic decision-making processes. In this context, the integration of analytics technologies, artificial intelligence, and distributed computing systems has become an essential component in building modern data analysis ecosystems [29].

The management of large-scale multimedia data is also closely related to the integration of digital technologies that improve data processing quality and information security. Technologies such as blockchain, cloud computing, and artificial intelligence-based analytics are increasingly implemented to ensure that generated data can be processed efficiently and utilized as a foundation for strategic decisions. These technologies not only enhance the efficiency of data processing but also contribute to the development of transparent and sustainable digital ecosystems across various industries [30].

Furthermore, the advancement of modern computing infrastructures enables multimedia data processing to be conducted in distributed environments through cloud and

edge computing architectures. This approach allows data analysis to be performed faster while reducing latency in large-scale data processing. By leveraging machine learning techniques and distributed analytics systems, organizations can obtain deeper insights from complex multimedia datasets, which ultimately support analytical needs in creative industries as well as other big data applications [31].

Visual Analytics for Large-Scale Multimedia Data Analysis

Visual analytics is an analytical approach that combines computational data analysis techniques with interactive visual representations to help users understand patterns, relationships, and trends within complex datasets. In the context of large-scale multimedia data, visual analytics plays a crucial role in transforming raw data into visual representations that are easier to interpret, enabling users to explore data more intuitively. This approach allows users to identify hidden patterns that may be difficult to detect using traditional analytical methods, particularly when dealing with high-dimensional and complex datasets [32].

The implementation of visual analytics in big data environments is closely related to the integration of various analytical techniques, including machine learning, data mining, and interactive visualization. The combination of automated analytical processes and human interpretation enables visual analytics systems to provide more effective support for data exploration. Through this approach, users can not only view visual representations of analytical results but also interact with the system to explore multiple interpretations of the analyzed datasets [32].

Moreover, visual analytics plays an important role in helping organizations understand data dynamics in continuously evolving digital environments. In areas such as network security analysis and distributed system monitoring, data visualization can assist in identifying cyberattack patterns, network anomalies, and system behavior changes in real time. Therefore, visual analytics functions not only as a data exploration tool but also as a critical component in intelligent analytics systems capable of supporting data-driven decision-making across various application domains [33].

Integration of Machine Learning in Multimedia Analysis

Machine learning has become one of the key technologies used in modern multimedia data analysis. This technology enables computer systems to learn patterns from large volumes of data and generate predictive models that can be applied in various analytical tasks. In multimedia contexts, machine learning techniques are widely used for applications such as visual pattern recognition, multimedia content classification, user behavior analysis, and anomaly detection within digital systems. The importance of machine learning continues to grow as the volume and complexity of multimedia datasets increase across multiple digital applications [34].

One widely adopted approach in multimedia analytics involves integrating multiple machine learning models into hybrid or ensemble learning frameworks. This approach allows analytical systems to combine the strengths of different algorithms in order to produce more accurate and robust analytical models. Hybrid models that integrate multiple machine learning techniques can significantly improve the system's capability to detect complex patterns within multimedia datasets and enhance analytical performance in distributed computing environments [32].

Additionally, the development of federated learning technologies enables distributed data analysis without requiring centralized data storage. This approach is particularly relevant for large-scale multimedia processing because it allows organizations to utilize data from multiple sources while preserving privacy and data security. By adopting federated learning frameworks, analytical systems can generate more representative models that support multimedia analysis applications in large-scale big data environments [34].

Interactive Visualization in Creative Industries

Interactive visualization is an essential component of visual analytics systems that enables users to interact directly with data through dynamic visual interfaces. In the creative industry sector, this technology plays a critical role in helping professionals understand trends, media consumption patterns, and user preferences across various forms of digital content. Through interactive visualization, users can explore multimedia datasets more flexibly and discover new insights that can support both creative and strategic decision-making processes [35].

Furthermore, interactive visualization enhances user engagement in the data analysis process. By employing dynamic visualization techniques, users can gradually explore data and adjust visual displays according to their analytical needs. This capability is particularly valuable in creative industries where a deeper understanding of user behavior and evolving digital market trends is required [36].

The development of interactive visualization technologies is also increasingly supported by the integration of other digital technologies such as Internet of Things systems, real-time analytics, and cloud-based digital platforms. These technological integrations allow visualization systems to process and present data more efficiently while providing relevant insights for users in various digital application contexts. As a result, interactive visualization has become a fundamental component in the development of modern analytics systems capable of supporting the needs of creative industries and data-driven digital ecosystems [33].

Visual Analytics as a Decision Support System

Visual analytics functions not only as a tool for data exploration but also as an important component in decision support systems. In modern organizations, the ability to quickly and accurately interpret large volumes of data has become a critical factor in determining business strategies and organizational policies. By utilizing visual analytics, decision makers can observe key performance indicators visually and understand relationships among different variables within complex datasets [30].

Decision support systems based on visual analytics also enable the integration of multiple data sources into a unified analytical platform. By combining data from various digital systems, organizations can obtain a more comprehensive understanding of operational conditions and emerging market trends. This integration allows decision-making processes to be conducted more efficiently while relying on accurate data-driven insights [33].

In addition, visual analytics enhances organizational capability in addressing challenges within complex digital environments. Through intelligent analytical technologies, organizations can monitor system indicators in real time and identify potential issues before they impact overall organizational performance. Consequently, visual analytics represents a strategic approach in developing modern analytical systems that support data-driven decision-making across multiple industry sectors [30].

3. Proposed Method

The research methodology focuses on designing and implementing interactive visualization dashboards tailored to creative industries like film, music, and digital art. The study will collect multimedia datasets (e.g., video, audio, digital artwork) through case studies in these industries, using publicly available sources and industry collaborations. An expert-based usability evaluation will assess the dashboards' effectiveness in supporting decision-making, with feedback collected through structured interviews and surveys. Data analysis will combine qualitative insights from case studies and expert feedback, and quantitative metrics such as task completion time and user satisfaction to evaluate the performance and utility of the visualization tools in real-world creative contexts.

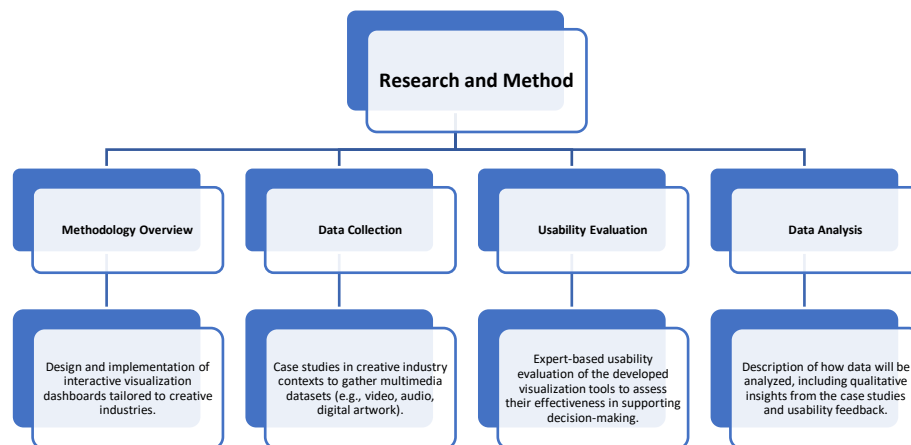


Figure 1. Flowchart structure.

Methodology Overview

The methodology for this research focuses on the design and implementation of interactive visualization dashboards tailored to the specific needs of the creative industries. The goal is to create dynamic, user-friendly dashboards that facilitate data exploration and decision-making within creative contexts such as film, music, and digital art. These dashboards are designed to handle large multimedia datasets, providing users with tools to interactively explore data through various visual encodings and interactive elements like filters and drill-downs. The dashboards will be built with scalability in mind to accommodate the increasing volume and complexity of multimedia data in creative industries.

Data Collection

To gather multimedia datasets, this research will utilize case studies from the creative industries, specifically focusing on sectors that rely heavily on multimedia data, such as the film, music, and advertising industries. The datasets will include video, audio, and digital artwork, which are commonly used in these sectors. Data will be collected from publicly available sources, industry reports, and collaborations with creative industry professionals. The aim is to gather a diverse range of multimedia content that reflects real-world data used in creative decision-making.

Usability Evaluation

An expert-based usability evaluation will be conducted to assess the effectiveness of the developed visualization dashboards in supporting decision-making within creative industries. The evaluation will involve industry professionals who are familiar with multimedia data and decision-making processes in the creative sectors. Experts will interact with the dashboards to perform specific tasks, such as analyzing audience engagement metrics, identifying patterns in content consumption, and making strategic decisions based on the visualized data. Feedback from the experts will be collected through structured interviews and surveys to identify usability issues and areas for improvement in the dashboards.

Data Analysis

The collected data will be analyzed using a combination of qualitative and quantitative methods. Qualitative insights will be drawn from the case studies and expert feedback, focusing on the effectiveness of the visualization tools in real-world creative contexts. The expert feedback will be analyzed to identify recurring themes related to the ease of use, utility, and impact of the dashboards on decision-making processes. Quantitative analysis will be used to assess the performance of the dashboards, including metrics such as the time taken to complete tasks, the accuracy of insights generated, and user satisfaction. This mixed-methods approach will provide a comprehensive understanding of how interactive visualizations can enhance decision-making in the creative industries.

4. Results and Discussion

The usability evaluation of interactive visualization dashboards showed that they significantly enhanced decision-making in creative industries by enabling faster insight discovery and improved pattern recognition. Users were able to explore large multimedia datasets intuitively, uncovering trends and making informed decisions in real-time, particularly in sectors like film, music, and advertising. However, challenges such as scalability and performance limitations arose when handling large datasets, causing delays in data processing. Additionally, some users struggled with the interface, requiring more training to maximize the tools' potential. To improve, optimizing dashboard performance for big data, enhancing user interfaces, and integrating advanced machine learning techniques are recommended to ensure continued effectiveness in dynamic, data-driven decision-making.

Results

The usability evaluation of the interactive visualization dashboards revealed that the tools significantly facilitated faster insight discovery and improved pattern recognition within large multimedia datasets. Users were able to quickly identify trends, patterns, and outliers in the data through the dynamic dashboards, which provided real-time visualizations and interactive features such as filters and drill-down options. This capability was particularly beneficial for decision-makers in the creative industries, enabling them to explore complex data intuitively and make informed decisions promptly. For instance, in the film industry, users could easily visualize audience engagement metrics across different genres, leading to more targeted content strategies. Similarly, in the music industry, the dashboards allowed users to explore streaming data, helping inform release schedules and promotional strategies.

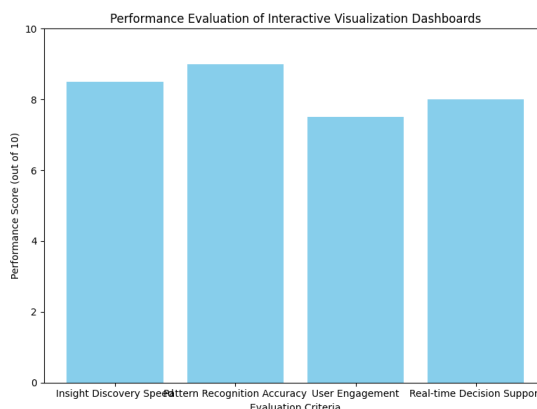


Figure 2. Performance Evaluation of Interactive Visualization Dashboards.

The bar chart above illustrates the performance evaluation of the interactive visualization dashboards based on key criteria: insight discovery speed, pattern recognition accuracy, user engagement, and real-time decision support. As shown, the dashboards scored highest in pattern recognition accuracy and insight discovery speed, highlighting their effectiveness in quickly identifying trends and providing valuable insights from large multimedia datasets. However, user engagement and real-time decision support could benefit from further optimization, particularly in terms of improving user interface design and scalability for larger datasets.

The application of pattern recognition techniques also enhanced the analysis process. Machine learning algorithms integrated into the dashboards identified complex patterns in multimedia data, such as user preferences in video content or music genres, that would have been difficult to detect using traditional analysis methods. These findings were particularly impactful for industries like advertising and entertainment, where understanding consumer behavior and engagement is crucial for optimizing strategies. The ability to recognize these patterns in real time helped users make more accurate predictions and take timely actions, ultimately leading to more successful content and marketing decisions.

Discussion

The interactive visualization dashboards significantly improved decision-making processes within the creative industries by facilitating quicker and more accurate insights from large multimedia datasets. These tools allowed users to interact with the data, enabling them to explore it dynamically and intuitively. By visualizing data through interactive elements such as filters and drill-downs, users were empowered to uncover insights that were previously hidden in large, complex datasets. In sectors like film and music, where real-time audience engagement data is critical, these dashboards provided a clear advantage in making data-driven decisions, such as adjusting content strategies or optimizing marketing efforts. The real-time capabilities of the dashboards also supported timely decisions, which is crucial in industries that rely on quickly adapting to audience preferences and trends.

Despite the positive impact on decision-making, several challenges were encountered during the implementation of the dashboards. One significant issue was scalability, as the dashboards faced performance limitations when handling large volumes of multimedia data. As the datasets grew, users experienced delays in processing and displaying the data, which hindered the real-time analysis capabilities of the tool. This challenge suggests that while the dashboards are effective for smaller datasets, further optimizations are needed to handle big data in a seamless manner. Additionally, there were some user acceptance issues, particularly with less tech-savvy users. Although the dashboards provided intuitive and engaging features, some users required more time to familiarize themselves with the tools and fully understand how to interact with the visualizations. Therefore, additional training and guidance would be beneficial to ensure that all users can maximize the potential of these tools.

Looking ahead, there are several areas for improvement to enhance the effectiveness of the visualization dashboards. First, optimizing the performance of the dashboards to handle larger datasets is crucial. This could be achieved by implementing more efficient data processing algorithms or utilizing cloud-based computing solutions to distribute the computational load. Additionally, enhancing the user interface and providing more comprehensive training resources could help improve user acceptance, especially for those unfamiliar with interactive data visualization tools. Finally, integrating more advanced machine learning and data mining techniques could improve the accuracy of pattern recognition and trend forecasting, providing even more actionable insights for decision-makers. These improvements would ensure that the dashboards continue to support the creative industries effectively, even as data complexity and volume continue to grow.

5. Comparison

When comparing visual analytics techniques to traditional methods, several key differences emerge. Traditional methods, such as static visualizations and text-based analysis, often rely on predefined charts and graphs, which limit users' ability to interact with the data dynamically. In contrast, visual analytics offers interactive features, such as real-time dashboards, filters, and drill-down options, enabling users to explore the data in a more flexible and intuitive way. Traditional methods also require a more manual approach to data exploration, often requiring users to review static reports or interpret lengthy text-based summaries, which can be time-consuming and inefficient. Visual analytics, however, streamlines this process by allowing users to engage directly with the data, uncovering insights and patterns that would otherwise be difficult or impossible to detect using traditional analysis methods.

The strengths of visual analytics lie in its interactivity, user engagement, and speed of insight discovery. One of the primary advantages of visual analytics is its ability to facilitate real-time, interactive data exploration. Users can engage with the data in a hands-on manner, adjusting filters, zooming in on specific data points, and drilling down into the underlying details, which enhances the depth of insights they can uncover. This interactivity makes visual analytics particularly valuable for decision-makers who need to respond quickly to changing trends and emerging patterns. Unlike static methods, visual analytics allows users to uncover insights faster by visualizing large datasets in a way that is easily understandable. This speeds up the decision-making process, enabling more timely and accurate actions based on data.

Visual analytics is particularly well-suited for big data applications, especially when dealing with large-scale multimedia datasets. Traditional methods often struggle to handle the volume, velocity, and variety of big data, as they lack the computational power and flexibility

to process and analyze vast, complex datasets in real time. In contrast, visual analytics systems are specifically designed to handle these challenges, offering scalable solutions that can process and visualize big data efficiently. By integrating advanced computational techniques such as machine learning and deep learning, visual analytics systems are capable of processing large volumes of data while still providing interactive and meaningful insights. This makes visual analytics a superior tool for analyzing multimedia content, such as images, videos, and audio, where the complexity and scale of the data would overwhelm traditional analysis methods.

6. Conclusions

The usability evaluation of interactive visualization dashboards demonstrated the significant benefits of visual analytics tools in enhancing decision-making processes within the creative industries. By providing dynamic, real-time visualizations and interactive features, visual analytics enabled faster insight discovery, improved pattern recognition, and more informed decisions. These tools facilitated a deeper understanding of complex multimedia datasets, which helped decision-makers in sectors such as film, music, and advertising optimize strategies and engage with audiences more effectively. The ability to interact with and explore data intuitively not only improved the speed and accuracy of decision-making but also allowed users to uncover patterns that would otherwise have been difficult to identify using traditional analysis methods.

The practical benefits of integrating interactive visual analytics techniques into industry workflows are significant. By leveraging these tools, organizations can enhance their ability to make data-driven decisions in real-time, leading to more efficient and effective outcomes. In creative industries, for instance, visual analytics tools allow for more targeted content creation, strategic marketing, and audience engagement, which are critical in today's fast-paced, data-driven environments. These techniques also enable better resource allocation and risk mitigation by providing decision-makers with immediate access to insights and patterns in large datasets. As organizations continue to adopt visual analytics tools, they can expect greater efficiency, improved decision quality, and a more informed approach to problem-solving.

Future research opportunities in visual analytics lie in addressing the remaining challenges and expanding the application of these tools to other sectors and datasets. One area of focus could be optimizing the performance and scalability of visual analytics systems, particularly in handling even larger and more complex datasets. Improving the usability and accessibility of these tools for non-technical users is another important direction for research, ensuring that visual analytics can be widely adopted across industries. Additionally, the integration of emerging technologies such as artificial intelligence, virtual reality, and blockchain into visual analytics systems could enhance their capabilities and further extend their applications in diverse fields. By exploring these research directions, visual analytics can continue to evolve and provide valuable insights in an increasing number of domains.

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